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# USSR Report

MILITARY AFFAIRS

AVIATION AND COSMONAUTICS

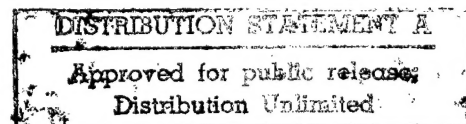
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8 JULY 1986

## USSR REPORT MILITARY AFFAIRS

### AVIATION AND COSMONAUTICS

No 1, January 1986

Except where indicated otherwise in the table of contents the following is a complete translation of the Russian-language monthly journal AVIATSIYA I KOSMONAVTIKA published in Moscow.

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AF CIC URGES BETTER RETURN ON TRAINING EFFORT

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 86 (signed to press 2 Dec 85) pp 1-3

[Article by twice Hero of the Soviet Union Mar Avn A. Yefimov, commander in chief of the Air Forces and USSR deputy minister of defense: "Our Military Labor for the Homeland"]

[Text] The intense rhythm of life in our great country, which has entered the 12th Five-Year Plan, is today being determined by active preparations for the 27th CPSU Congress. Active work is going on in the party, workforces, and within the broadest segments of the population to discuss, publicize, and explain the draft pre-congress documents and decisions of the 4th Session of the USSR Supreme Soviet, 11th Convocation, which were ratified by the October (1985) CPSU Central Committee Plenum. At the center of attention of all Soviet citizens is the report submitted by CPSU Central Committee General Secretary Comrade M. S. Gorbachev at the party Central Committee plenum, drafts of the new revised Program of the Communist Party of the Soviet Union, changes in the CPSU Rules and Basic Directions of Economic and Social Development of the USSR for 1986-1990 and the Period Up To the Year 2000. "These are documents of enormous political significance," CPSU Central Committee General Secretary Comrade M. S. Gorbachev stressed at the Plenum. "They deal with our programmatic goals, key aspects of the party's general line of policy, its economic strategy, forms and methods of work with the masses in today's exceptionally complex and critical period of history, which in many respects -- both at the domestic and international level -- is of the nature of a turning point."

Military aviation personnel, just all other Soviet citizens, unanimously endorse and enthusiastically support the course of policy adopted by the party which focuses on speeding up this country's socioeconomic development and achieving on this basis a qualitatively new level for the Soviet society, as well as the consistent, purposeful activities by the CPSU and Soviet Government to strengthen our homeland's economic and defense might and to avert the threat of a nuclear world war.

Our achievements in the social domain are undisputed. Equal rights to labor and fair labor remuneration have been secured. Soviet citizens today enjoy such benefits as free medical care and education, as well as housing at a

minimal cost. An indistructible alliance of the worker class, kolkhoz peasantry and intelligentsia has been established in the Soviet society. Women have been given genuinely equal rights with men, while a sure road to the future has been opened up for the younger generation, and social security has been guaranteed for veterans of labor. Soviet citizens are justly proud of all this.

But the party teaches us that no matter how inspiring formulated plans may be, specified targets and performances can be achieved only by intensive, highly-productive labor. The pre-congress documents are also mobilizing Soviet Armed Forces personnel to selfless military labor in the name of the homeland. In these documents' content-filled lines, theses, points, and conclusions military personnel see in a new light their duty to the people pertaining to further strengthening organization and discipline and increasing vigilance and combat readiness. They are assessing past achievements in an exacting and businesslike manner, are synthesizing and placing in the service of combat readiness advanced know-how in organizing the training and indoctrination process, flight operations shifts, socialist competition, and are aggressively mobilizing unutilized reserve potential.

Following are the principal slogans for today: pace, quality, organization, discipline, thrift, and economical utilization of labor, material, and financial resources.

Extensively engaged in socialist competition to honor the 27th CPSU Central Committee Congress in a worthy manner, many Air Forces units have achieved excellent results in combat and political training, in strengthening discipline, and increasing organization and order. Top-performing Air Forces units have been awarded Certificates of Merit for successes in military labor and for meeting adopted socialist pledges in honor of the 40th anniversary of the Victory of the Soviet people in the Great Patriotic War and the 27th CPSU Congress. These include the units in which officers A. Tsarkov, V. Grachev, V. Kudryavtsev, and P. Tarasevich serve.

But every member of the Air Forces must bear in mind at all times that the constructive activities of the Soviet people are today being carried out in conditions of a complex international situation and a growing military threat on the part of aggressive imperialist circles. The forces of peace and social advance are opposed by the most reactionary imperialist circles, headed by the United States. The essence of their policy essentially consists in the social process of recouping losses or getting even on the basis of achieving military superiority over socialism, applying powerful pressure on progressive, liberation movements, and maintaining international tension at a level which would justify the development of more and more new weapons of mass destruction and the militarization of space.

The further improvement of nuclear and conventional weapons is leading to increased danger of an aggressor sneak attack. This requires further strengthening of our country's defense capability and an all-out increase in the combat power and combat readiness of our Armed Forces. Noting the particular importance of this task, Comrade M. S. Gorbachev stressed at the April (1985) CPSU Central Committee Plenum: "Nor shall we stint in the future

any efforts to ensure that the USSR Armed Forces have everything they need for the reliable defense of our homeland and its allies, to ensure that nobody can catch us unawares."

The interests of the security of our socialist homeland demand that the Air Forces be prepared at all times to inflict a devastating defeat on any aggressor. In order to carry out this responsible mission with honor, Air Forces personnel must in the future continue making an all-out effort to increase political vigilance, to ensure a high degree of troop combat readiness, continuously to strengthen military discipline, and most rigorously to carry out the demands of military regulations and orders by command personnel.

Combat readiness and fighting efficiency of units and subunits are achieved, first of all, by purposeful ideological-political and indoctrination work among personnel, intensive training at ranges, airfields, and in classrooms, by constant study of military equipment, by mastering the modes of its combat employment and by maintaining it in continuous readiness for action; secondly, by the organizational activities of command cadres, staffs, political agencies, party and Komsomol organizations, rear services units and establishments, which are thoroughly trained and prepared to perform their duties in a combat environment. In work to increase combat readiness and combat efficiency there should be no room for stagnant, obsolete modes of training and indoctrinating personnel or outmoded methods of employing combat equipment and weapons.

High quality and effectiveness of combat training are important criteria of troop combat readiness. They should permeate all elements from which Air Forces combat readiness and combat efficiency are formed.

And this requires thorough organization of combat and political training, continuous improvement of its methods, incorporation of positive know-how into the training process, elimination of unnecessary relaxation of demands and situation simplification, with greater attention devoted to searching for and adopting the most effective methods of training and employment of combat equipment and weapons, and learning to hit the enemy on the first pass.

One essential condition for further improving quality of training is purposeful, efficient expenditure of resources allocated by the state to the Air Forces. Every ton of fuel, every missile, and every hour of equipment operation should be utilized with maximum return in order to increase personnel combat readiness and quality of air proficiency. Every minute an aircrew spends in the air must be utilized with maximum return, by improving planning and scheduling of flight operations and by combining separate combat maneuvers and drills. It is essential more boldly and resolutely to adopt the latest scientific and technical advances in order to improve aircraft equipment and weapons, airfield service facilities, means of troop support, command and control, making every effort to ensure that Air Forces combat training is in conformity with the current level of development of science and technology.

In troop training and indoctrination, paramount attention should be focused on tactical, weapons, and technical training of flight personnel, as well as bold, resolute and initiative-filled actions by flight personnel in performing combat training missions. It is necessary to have the ability to beat the adversary in maneuver and weapons delivery and to display stratagem, sharpness of wit and ingenuity in a prompt and timely manner. These qualities are developed in the process of thorough, comprehensive preparation for each training flight, preliminary modeling of the training mission, finding an optimal mission execution variant, and mission execution in the air with initiative.

Moral-psychological readiness of aviation personnel immediately to engage in combat and to conduct aggressive combat is assuming greater significance today than ever before in the past. Excellent flying skill on the part of individual combat pilots should be combined with sure, precise formation flying and smooth combat coordination on the part of two-aircraft elements, flights, and squadrons.

Further increase in combat readiness is closely linked with ensuring mishap-free flight operations. The campaign for flight safety is a matter of great national importance. In accomplishing this, commanders, political workers, staff officers and party organizations should concentrate their attention on increasing the job proficiency and proficiency rating of aviation personnel as well as technical knowledgeability in servicing, maintaining and operating aircraft and weapons. It is important in this matter to achieve strict, unswerving observance of the rules and regulations of flight service by all persons who are directly involved in preparation for and conduct of flight operations. It is essential to increase efficiency in the operations of staffs, as well as the responsibility of all services for organization and quality of ensuring successful accomplishment of flight training plans and schedules. The quality and results of the various types of training exercises should be improved.

Successful accomplishment of the tasks of the training year is determined in large measure by the state of military discipline and firm observance of regulations in Air Forces units and subunits. Commanders, political agencies, staffs, party and Komsomol organizations should work in a suitable manner and on a daily basis on strengthening them, proceeding from the requirements of our party. Each and every breach of military discipline must be firmly assessed, its causes fully determined, and decisive measures must be taken to prevent such infractions, for the moral atmosphere in the military collective and its degree of cohesiveness also determines the quality of accomplishment of tasks assigned to aviation personnel. Communists and Komsomol members are called upon above all others to display a personal example in strict observance of orderly routine.

Professional skill on the part of aviation personnel, smooth rhythm and efficiency of combat training, as well as effectiveness of competition depend in large measure, as we know, on quality of planning and scheduling of combat and political training. It is precisely due to inadequate attention to this matter that in the last training year there occurred in some units errors of omission in combat training, losses and inefficient expenditure of training

time and material resources. Commanders, staffs, and party organizations must give thought to mistakes made. Plans and schedules should focus personnel toward seeking new approaches to the performance of assigned tasks, toward displaying initiative and achieving excellent end results in shortening the training timetable and with the least possible expenditures. The experience of vanguard aviation units and combined units incontrovertibly demonstrates that successful accomplishment of assigned tasks depends in large measure on the ability of officer-leaders precisely to plan, schedule and organize personnel combat training, to maintain an innovational atmosphere in the military collective, and to organize the training and indoctrination process taking specific conditions into account.

A special concern is training of officers. It is necessary to teach them in a more substantive manner command and control of units and subunits, high-quality performance of assigned tasks in conditions of achieving savings in time and resources, organization of the training process, and maintaining firm observance of regulations and solid military discipline. One should more aggressively utilize combat experience and the experience of large-scale exercises of recent years in accomplishing this task. It is very important for all officers to be armed with knowledge of the fundamentals of military education science and psychology as well as Soviet laws, and that they skillfully utilize advanced know-how in political indoctrination work. The level of their professional training and ability to mobilize personnel to perform complex combat training missions should occupy the focus of attention in selection and placement of cadres.

In preparing for its 27th Congress, our party is holding each and every Communist more stringently to account for his personal contribution to the common cause and for his attitude toward civic duty. Therefore commanders, political agencies, staffs, and party organizations must have a more critical attitude toward their activities, step up the campaign against irresponsibility, wasting of training time, incorrect utilization of training facilities, and utilize the high degree of political enthusiasm on the part of military aviation personnel for successfully accomplishing the tasks proceeding from the demands of the pre-congress documents and instructions of the USSR minister of defense for the new training year.

The new draft revision of the Party Program clearly spells out important tasks: "The Armed Forces and state security agencies should display a high degree of vigilance and be prepared at all times to nip in the bud imperialist intrigues against the USSR and its allies and to crush any aggressor.

"...The CPSU will continue in the future unfailingly to concern itself with ensuring that the combat potential of the Soviet Armed Forces constitutes a solid fusion of military skill, ideological staunchness, organization and discipline on the part of personnel, their faithfulness to patriotic and internationalist duty, and a high level of technical equipment."

Intensive combat training is currently in progress in the Air Forces. It is taking place under the life-giving effect of extensive discussion and study of pre-congress party documents. By grasping its programmatic goals and tasks as well as the import of foreign and domestic policy, military aviation personnel

become imbued with the endeavor to work even more persistently to increase their vigilance and combat readiness and to strengthen discipline and order.

The quality of execution of training curricula and programs is inseparably linked with further development of socialist competition. In the current training year, at the initiative of the men of a Red-Banner guards bomber regiment, competition under the slogan "We shall implement the decisions of the 27th CPSU Congress, and we shall reliably defend the achievements of socialism!" is in full swing in the Air Forces. Right now, when new levels of combat performance have been spelled out in individual and group pledges in the units, it is very important not to permit excessive regimentation, predictable fixed routine and excessive attention to form with consequent detriment to content, to provide a proper outlet to personnel creativity and initiative, and to focus them first and foremost toward accomplishing the main tasks of combat readiness. Not one single useful undertaking which fosters intensification of the training process and strengthening of an economy regimen should be left unsupported. It is essential to devote constant attention to initiative directed toward further improving competition between regiments and the vanguard combined unit movement. One should also give thought to how one can increase the indoctrination role of competition and what should be done in order to ensure that its forms and methods are more fully in conformity with the demands of the time.

Military aviation personnel, solidly ranked behind the Leninist party Central Committee, are preparing to honor the 27th CPSU Congress with additional successes in combat and political training. By their selfless labor they are strengthening the defense might of our socialist homeland. Its winged defenders should be ever alert, in a continuous state of combat readiness!

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## PILOTS FLY RECONNAISSANCE TRAINING SORTIES

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 86 (signed to press 2 Dec 85) pp 4-5

[Article, published under the heading "Be Alert, In a Continuous State of Combat Readiness," by Doctor of Military Sciences Col A. Krasnov: "Utilizing the Capabilities of the Equipment"]

[Text] Receiving clearance to take off, Military Pilot 2nd Class Capt L. Makushev routinely brought the engine up to takeoff power and cut in the afterburner. After a short takeoff roll, the aircraft lifted off and began a high-speed climbout. Soon the aircraft was approaching the "FEBA."

Captain Makushev was tasked with the mission of scouting out the location of "enemy" missile launchers. Back on the ground, when he was preparing for the mission, he had determined the route and flight profile so as maximally to utilize his aircraft's performance capabilities. In view of the considerable distance to the objective area, the reconnaissance pilot carefully calculated fuel requirements, figuring in bypassing SAM missile impact zones and execution of fighter-evasion maneuver.

Makushev crossed the "battle line" on schedule. At this moment he spotted an "enemy" fighter at a lower altitude, which was climbing in order to attack the reconnaissance aircraft at an advantageous angle.

His ploy was unsuccessful. Thoroughly knowledgeable on the performance characteristics of his own aircraft and that of the "adversary," Makushev executed the required evasion maneuver. As a result the interceptor fell behind, initially losing visual contact and subsequently radar contact with the target. The great speeds at which they were flying quickly separated the supersonic aircraft by a considerable distance.

As he approached the search area, the pilot proceeded to descend and switched on his radar. The principal phase of the mission was beginning. In order to obtain precise, undistorted radar images, Captain Makushev endeavored precisely to maintain straight-line flight, without the slightest deviations in heading, bank or pitch angle. In view of the capabilities of the long focal-length camera on board, on his approach to the next object of interest he proceeded to climb when at a calculated distance from it, photographing in

a pitch-up attitude. Prior to reaching the next object of interest, he executed a turn and photographed it while in a bank. The target installations' air defense assets were unable to offer countermeasures, as the aircraft was at too great a distance from them. Subsequently, skillfully executing a missile-evasion maneuver, the reconnaissance pilot avoided SAM fire and soon was back safely on the ground at his home field. The information he obtained helped the command authorities reach a decision in a prompt and timely manner and to strike important "enemy" installations.

What helped achieve successful accomplishment of this complex air mission? I believe that it was first and foremost Captain Makushev's excellent knowledge of his aircraft's capabilities and of his onboard reconnaissance gear, and his ability correctly and fully to utilize them taking the current situation into account. In order to be able to aim the optical axis of his camera precisely onto the target installations, as he maneuvered it was necessary to maintain the required flight parameters very precisely, as well as to maintain the proper time intervals between frames in order to obtain aerial photographs with overlapping coverage.

This task was not easy to accomplish. The pilot was well aware of this fact. Therefore he practiced on simulator equipment in advance, making careful calculations and making "dry runs" with his aircraft in various attitudes. He then modeled several flight variations in case the situation changed.

A modern reconnaissance aircraft is without question a complex technical package. It requires of the pilot thorough knowledge of the equipment and solid flying skills, for a pilot will be able to devote sufficient attention to seeking out target installations and maintaining airspace surveillance if his attention is not diverted to flying the aircraft and manipulating cockpit gear. It is not surprising that the bulk of methods work connected with training highly-skilled flight personnel boils down to developing a certain automatism in flying technique.

As practical experience indicates, however, this alone will not guarantee success. Different situations develop on a reconnaissance flight. Sometimes the flight is monotonously routine and requires automatism of actions by the pilot, but most frequently the reconnaissance pilot must think, analyze, and make decisions. And all this must be done quickly, with an acute shortage of time and information on the developing situation. Pilots who have experienced such situations claim that skills involving thorough deliberation and awareness are more helpful than unthinking execution of operations connected with purely mechanical memorization of procedure sequence in successfully getting through such situations. This is why a pilot's actions should be honed to a high degree of conscious automatism.

We should also address the following question in connection with this. Pilots continuously hone their skills. Toward this end they use various simulator devices and special equipment. But not all equipment helps improve skills to an equal degree.

Daily practice and drill sessions become burdensome to some aviators. Of course it is a rare person who does not become weary of frequent repetition of

one and the same actions, but it is necessary to be able to control oneself, to convince oneself that it is first and foremost a necessity, without which a pilot cannot advance in improving his flying proficiency.

There is a good deal of food for thought here for flight commanders and instructors as well. It is no secret that training classes are sometimes monotonous, excessively schematic, and tediously boring in large measure due to the passivity of flight commanders and instructors. Sometimes their subordinates keep doing the same thing day after day. This is an indication of excessive attention to form with consequent detriment to content.

It is unquestionably necessary repeatedly to practice specific flight elements. Otherwise one cannot attain a conscious and aware automatism in one's actions. But this does not mean that everything should boil down to established stereotypes. Practice sessions produce maximum benefit when they contain an interesting tactical element, when they take into consideration the pilot's improving level of proficiency, when they introduce something new, arousing one's active ingenuity, forcing one to think about how the capabilities of the equipment should best be used.

Development of skills aimed at effective utilization of these capabilities also continues when flying actual training missions. I believe, however, that a methodological error is being made by those commanders who, desiring to demonstrate the capabilities of the aircraft, fly it at the critical edge of the performance envelope. Naturally young pilots develop the desire to do likewise. Lacking adequate experience, however, when they repeat the "lesson" they may be unable to keep the aircraft under control. This is why it is important precisely to observe flight rules and regulations and the requirements of documents regulating flight operations.

In endeavoring more fully to utilize aircraft capabilities, flight personnel must bear in mind that this endeavor should be grounded on precise calculation. Prior to making a decision, a combat pilot should objectively weigh all the pros and cons. Unfortunately this does not always happen.

...Sr Lt V. Sinitsyn's aircrew was assigned a mission to photograph the disposition of "enemy" reserves. Unfortunately the aircrew failed to accomplish the mission, and here is why. After taking off, V. Sinitsyn discovered a camera failure which, as was subsequently ascertained, was the fault of the ground personnel. Nevertheless he failed to report this and decided to continue the mission. Naturally Sinitsyn failed to deliver complete and reliable reconnaissance data, placing the defending ground subunits in a difficult situation. One might logically ask what good could come of such "initiative"? The fact is that it brought nothing but harm. Under the circumstances it would have been much more intelligent to report the equipment malfunction to the flight operations officer and to return to the airfield. Then they would have sent another aircrew to perform this important mission. But Sinitsyn was apparently done in by his own self-assurance: he had figured he would conduct visual reconnaissance of something information on which could be obtained only by aerial photography.

The following incident also gives food for thought. As he was flying a reconnaissance mission, Capt A. Osidulov was determined to provide the command authorities with high-quality large-scale photographs. But desire alone to perform a successful reconnaissance mission proved insufficient. With poor knowledge of the equipment operating requirements, the pilot came closer than the minimum allowable distance to the installation of interest and took his pictures at top speed. As a result he photographed only portions of the target installation, and these pictures were not of the highest quality.

This incident confirms once again that knowledge of the capabilities of the equipment and the ability to utilize these capabilities are indissolubly linked from the standpoint of tactics. Full utilization of the capabilities of aircraft in order to achieve victory over the enemy is a matter which requires constant attention by aviation personnel.

The upgrading of combat hardware results in the search for new tactics. In order to find a fresh tactical move, a pilot should flawlessly master the aircraft system entrusted to his care, be familiar with the ranges of possible utilization, and have precise knowledge of the limits of the allowable. If this is done, each sortie will produce maximum effect, and this means a greater contribution toward increasing combat readiness.

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## BOMBING STRIKE DELIVERY TRAINING EMPHASIZED IN BOMBER REGIMENT

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 86 (signed to press 2 Dec 85) pp 7-8

[Article, published under the heading "Be Alert, In a Continuous State of Combat Readiness," by Maj Gen Avn M. Lebedev: "Bomber Training at the Focus of Attention"]

[Text] The CPSU considers it essential to continue in the future strengthening its organizing and guiding influence on Armed Forces life and activities, to strengthen the principle of one-man command, to enhance the role and influence of Army and Navy political agencies and party organizations....

From the draft revised CPSU Program

Intensive combat training is in progress in this bomber regiment, just as in other Air Forces units. Aviation personnel have been assigned large, difficult tasks. Taking part in socialist competition under the slogan "We shall carry out the decisions of the 27th CPSU Congress and reliably defend the achievements of socialism!", they are working persistently to master the combat capabilities of their aircraft system and are improving their moral-psychological conditioning, flying and tactical skills.

The efforts of commanders and political workers, engineers, technicians, party and Komsomol organizations are directed first and foremost toward achieving excellent end results in combat training, one of the most important elements of which is highly-effective bomber aircrew training.

We should note that the unit party committee, headed by Capt V. Shevchuk, and the party buros of the subunits, employing various forms of party work, are seeking to ensure that each and every Communist is precisely aware of his personal responsibility for the state of affairs in the subunit, is taking active part in subunit activities, is displaying an example in training, and has an implacable attitude toward shortcomings and unnecessary situation simplification. For example, in the squadron in which Military Pilot 1st Class Capt V. Ligayev serves as party organization secretary, aviation personnel are clearly aware that unnecessary situation simplification and unnecessary relaxation of demands diminish the men's activeness and dull

interest in the job, and this in the final analysis leads to violations of guideline documents and air mishap-threatening situations. The squadron's Communists are well acquainted with their tasks and are doing everything possible to improve combat readiness. Pilots and navigators, engineers and technicians regularly address meetings of the party buro, reporting on progress in their professional growth.

Subunit leader personnel, aware that an aviator's work fitness depends directly on his psychological mood, are always inquiring about the mood of their subordinates, their state of health, how they spend their off-duty time and, if necessary, help them properly organize their leisure time. This unquestionably has a positive effect on developing in aviation personnel the finest moral-fighting qualities, a strong feeling of responsibility for the results of their labor, and developing initiative and innovativeness in them. It is no coincidence that military discipline is high in the subunit and that appreciable success is achieved in military labor. For example, the average mark in aircraft navigation and bombing exceeds 4.5.

We should note that the unit party committee devotes special attention to improving the quality of aircrew bomber training. At party committee meetings they would discuss matters pertaining to improving the accuracy characteristics of the aviation system, the quality of navigation support, and other items pertaining to aviator combat proficiency. Bombing accuracy has increased significantly as a result of carrying out our designated measures. Aviation personnel have proceeded to seek out and master new tactics and modes of attack.

Performance of missions with less expenditure of manpower and resources is one of the important problems facing the unit command authorities. Instilling in aviation personnel a high degree of political consciousness and selflessness in carrying out one's military duty, commanders, political workers, and party organizations assign a paramount role to publicizing the Lenin military-theory legacy, the decisions of the 26th CPSU Congress and subsequent CPSU Central Committee plenums, drafts of a new revised Party Program and draft changes in the Rules of the Communist Party of the Soviet Union. A group of speakers has been formed in the unit at the initiative of the party committee, consisting of leader personnel and the most respected party members.

Lectures, reports, seminars on theory, discussions, and individual interviews help enhance the role of the human factor in accomplishing tasks pertaining to maintaining a high state of unit combat readiness. Demandingness on party members for carrying out party and professional duty has appreciably increased in the subunits commanded by Maj's V. Gorelkin and P. Korolev.

A great deal of work is being done both at the squadron and flight level. On one flight operations day, for example, the aircrew of Capt M. Kapre was unable to complete its training sortie on the range and carried bombs back to the airfield. Flight commander V. Akimov discussed this incident in detail with the men. A bit later party members listened to a report by the flight navigator on his personal responsibility in mastering the aircraft system. Specified and promptly implemented measures to improve the professional skills of the aviation personnel enabled them to avoid such incidents in the future.

Socialist competition, in progress with renewed intensity in the aviation subunits on the eve of opening of the forthcoming party forum, is helping improve the quality of navigation and bombing training. In the squadron under the command of Military Pilot 1st Class Maj V. Gorelkin, for example, a party meeting was devoted to organization of competition. Party members thoroughly analyzed the state of affairs and adopted upgraded pledges. They devoted special attention to publicizing skillful performance by vanguard personnel. Party members V. Khomutov and R. Zaripov, for example, always successfully perform complex flight assignments. They are genuine experts at bombing. They are just the ones to place in competition with one another! Or take, for example, Capt M. Nikonov and Sr Lt Yu. Sosnin. The level of training of these officers is almost identical. Therefore they should compete in skill and ability. They determined that the know-how of vanguard performers who have achieved high results in study and utilization of the aircraft system should be made available to all aviation personnel.

Competition on combat employment tasks and performance standards is particularly meaningful. Performance results, presented for public scrutiny after each training sortie and each flight operations shift, activates aircrew work performance, while performance results summaries, regularly presented by command personnel, with competition winners awarded challenge pennants, help promote increased combat skill.

Rally-type meetings of master combat performers and socialist competition winners as well as exchanges of know-how and various cultural-educational measures are held at the unit level to achieve publicity and comparability of competition results, synthesis and dissemination of advanced know-how.

As a rule these meetings of expert performers are held at the end of a period of training, when socialist competition results are already known. At this time specialist personnel share their experience and know-how in improving combat expertise, collectively determine the directions of subsequent mastery of the aircraft system, and draft recommendations for improving the quality of bombing training. This experience enables leader personnel to work out flight training methods.

Unfortunately recommendations are not always put into practice due to the press of daily work routine. It is precisely here that initiative by party members plays a very important role. They come to the party committee and express their opinion on various matters and errors of omission in daily activities. Important issues are raised at meetings of grass-roots level and primary organizations. Collectively-elaborated decisions and directions to take in work activities make it possible through joint efforts to correct deficiencies and successfully to handle daily affairs.

As we know, combat aircraft are group-serviced and maintained. Maintaining this equipment in a continuous state of combat readiness requires of each individual continuous improvement in his knowledge and skills. For example, the task of improving the quality of bombing training applies not only to flight personnel but also to the aviation engineer service specialists who service and maintain bombsight-navigation equipment and weapon systems. The

matter of training and breaking in young specialist personnel requires a great deal of attention in connection with this. Comradely mutual assistance helps rapidly train highly-skilled specialists. Experienced military aviation personnel pass on to the young newcomers their know-how in servicing and maintaining combat equipment, discuss possible malfunctions and methods of preventing them, and demonstrate the most efficient work techniques. Thanks to this, the young aviation specialists rapidly become experts at their job.

Proficiency category rating is an important indicator of a high degree of technical proficiency on the part of aviation personnel. The unit party committee, subunit party and Komsomol organizations devote unrelenting attention to improving proficiency ratings. Specialization-area technical study groups are in operation in the unit. A training class curriculum, schedule, and subject matter are drawn up for a training period. The party committee regularly receives reports from study group instructors on matters pertaining to expanding technical supervision and raising the level of the men's job knowledgeability.

The ultimate goal of all aircrew combat training is the ability to hit the target with the first bomb on the first bombing run. Toward this end aircrew personnel study the equipment, aerodynamics, tactics and weapons, learn to fly the aircraft skillfully day and night, and master various maneuvers in all weather conditions.

Errors of omission and uncompleted efforts occur, however, which lead to serious errors. Once the range officer noticed during bombing and air-to-ground gunnery that flight personnel were making mistakes in the process of maneuver execution. In addition, the airmen were deriving no sense of satisfaction, which is always experienced after a well-executed mission.

Before making mission results public, supervisors examined the flight data recorder tapes in detail. It was ascertained that the errors had been caused by failure to heed the aircraft's aerodynamic peculiarities. The errors were analyzed in detail by the unit's methods council. Requisite recommendations for flight personnel were formulated. Also particular attention was focused on the matter of methods training of squadron and unit command personnel. As a result of the measures which were taken, as well as purposeful party-political work, the subunits succeeded in virtually totally eliminating shortcomings in aircrew training. In the squadron commanded by Maj V. Gorelkin, for example, party political measures which help improve quality of bombing training are planned, scheduled, and carried out taking into account the requirements of guideline documents governing flight operations. Vanguard-performer airmen exchange experience and know-how with the less experienced men on specific aspects of combat employment or aircraft servicing and maintenance. Seminars, training classes and ground rehearsal of different variations of delivery of bombing strikes are held in the squadron on a regular basis, especially during the time of exercises.

At one exercise aircrews were performing a mission based on a surprise scenario change by the exercise director. The mission was accomplished with a mark of excellent. Modeling of air missions and strike delivery variations worked out in advance stood the aircrews in good stead. Success was also

fostered by purposeful party political work aimed at forming excellent moral-fighting qualities in the men as well as personal example by leader personnel. Squadron deputy commander for political affairs Maj S. Mityanishev, for example, is distinguished by a high degree of ideological conditioning, professional competence, discipline and efficiency, a sense of duty, and a unity of word and deed. Party member Mityanishev, working together with the subunit command authorities, resolutely nips in the bud the slightest instances of unnecessary relaxation of demands in the training process as well as excessive attention to form with consequent detriment to content in indoctrinational work. It is not mere accident that the squadron's party and Komsomol activists display an example in training, performance of job duties and discipline, and in meeting socialist pledges, nor is it mere happenstance that the squadron is rated excellent.

In present-day conditions successes in combat training and socialist competition directly depend on the scope and depth of party political work. Applying an individual approach in training and indoctrination of military aviation personnel, the unit's command authorities, party and Komsomol organizations endeavor to ensure that each and every man, being thoroughly aware of the significance of his labor, constantly studies the weapons and combat equipment entrusted to his care. The unit's command personnel, political workers, and party activists always bear in mind the vanguard role of Communists as a political nucleus of military collectives. Seeking effectiveness and efficiency of party political work in all areas of military labor, they endeavor to ensure excellent quality of aviation personnel air and tactical performance as well as unswerving increase in the professional skill of the defenders of the socialist homeland.

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## MILITARY ASPECTS OF CPSU PARTY PROGRAMS REVIEWED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 86 (signed to press 2 Dec 85) pp 10-11

[Article, published under the heading "Anticipating the 27th CPSU Congress," by Candidate of Historical Sciences Col Yu. Silchenko: "Military Issues in Party Programs"]

[Text] The 27th CPSU Congress will soon convene. Its decisions will without question become an important milestone in our country's development. The draft revised CPSU Program, which has been widely disseminated for public discussion, encompasses all areas of the socioeconomic, political, and ideological affairs of the Soviet society, presents a clear Marxist-Leninist appraisal of past accomplishments and defines the strategic tasks facing the party and people at the present, exceptionally complex and critical historical stage. This most important political document reflects with an adequate degree of completeness the fundamental trends in world development. It presents good points of reference for formulating a correct course of policy in today's tense international situation.

"The Third Party Program in its present version," noted CPSU Central Committee General Secretary Comrade M. S. Gorbachev at the October (1985) CPSU Central Committee Plenum, "is a program of planned, orderly, comprehensive improvement of socialism and further advance by Soviet society toward communism on the basis of acceleration of our country's socioeconomic development. It is a program of campaign for peace and social advance."

The draft revised CPSU Program devotes adequate attention to matters pertaining to ensuring reliable protection of socialist achievements and further strengthening of this country's defense capability as a guarantee of successful implementation of the grandiose plans of economic and social development of our state. The draft contains ideas and points which show Soviet experience in military organizational development and efforts by the CPSU to strengthen the defense capability of the Soviet State in the face of a constant military threat on the part of international imperialism, headed by the United States.

Of the military problems reflected in previously adopted CPSU programs as well as in the draft new revised Program, the following are stressed: the need for

armed defense of the socialist homeland, and principles of Soviet military organizational development.

The need for armed defense of the achievements of the revolution and establishment of a military organization of the proletariat was emphasized back in the first Party Program, adopted by the Second Congress of the RSDWP [Russian Social Democratic Workers' Party] in 1903. It proclaimed "replacement of a regular army by general arming of the people."

This direction in party military policy was in conformity with Marxist ideas and Lenin's teaching on defense of the socialist homeland. Long before the victory of the dictatorship of the proletariat, V. I. Lenin theoretically proved the objective need for and the vital importance of such defense. Having thoroughly studied the laws governing the development of capitalism at its imperialist stage, he concluded the possibility and inevitability of victory of a socialist revolution in a single country. V. I. Lenin held that such a situation "should evoke not only friction but an outright attempt on the part of the bourgeoisie of other countries to crush the victorious proletariat of the socialist state." For this reason the victorious proletariat "should prove in deed that it is not only capable of overthrowing the exploiters but also of organizing for self-defense" and of establishing its own combat-efficient army.

History has confirmed V. I. Lenin's foresight. The exploiter classes overthrown in Russia did not want to accept rule by the proletariat and unleashed a civil war, while the imperialist bourgeoisie of the United States, Germany, Great Britain, France, Japan, and other countries organized military intervention against the Soviet Republic. The fate of the revolution was decided on the battlefronts, where the Red Army was born and waxed strong in the flame of battle.

The party's Second Program was also permeated with the idea of constant readiness for military defense of the socialist homeland. It stated that the party considers it essential to maintain a strong regular army of the socialist state in order to defend the achievements of the socialist revolution against external and domestic foes.

The question of the need for reliable armed defense of the achievements of socialism was also clearly reflected in the Third Party Program, adopted at the 22nd CPSU Congress, since the aggressive nature of imperialism had remained unchanged, in spite of further weakening of its position.

In the draft new revised Party Program, the Communist Party, viewing the question of war and peace as the principal issue of the present day, confirmed that it has been and continues to be an active supporter of peaceful coexistence between countries with differing societal and political systems.

Imperialism, however, does not want to accept the political realities of today's world. Ignoring the will of peace-loving peoples, reactionary imperialist circles in the United States and the other NATO countries are fiercely resisting societal advance and are attempting to alter the course of history, to undermine the position of socialism, and to recoup their social

losses on a worldwide scale. "The citadel of international reaction," stresses the draft new revised CPSU Program, "is U.S. imperialism. The threat of war emanates first and foremost precisely from this source."

Openly counting on crude force, the United States and other NATO countries are escalating the arms race unchecked. Never before in U.S. history has the military budget grown so rapidly in peacetime as in recent years. In 1986 that country's military appropriations will total in excess of 302 billion dollars, 10 billion dollars more than in 1985.

U.S. schemes to militarize space present a particular threat to the cause of peace. "Star Wars" plans are a U.S. attempt to acquire the capability to deliver a nuclear attack on the Soviet Union with impunity, protected against retaliation by an antimissile space "shield."

The present U.S. Administration, pursuing imperial, hegemonist aims, has undertaken extensive military preparations in the Far East where, together with Japan and South Korea, it is setting up an aggressive bloc, a kind of branch organization of NATO. The United States is continuing to meddle in the internal affairs of many countries. It is to blame for the development of the dangerous situation in Central America, in Southern Africa, and in the Near East. U.S. imperialism is continuing its undeclared war against Afghanistan.

The growing military threat on the part of the United States and its NATO allies requires continuous strengthening of the defense capability of our homeland and increasing the combat power of the Soviet Armed Forces. This is why, fighting to preserve peace and prevent another world war, the party considered it essential to state the following in the new, revised version of its Third Program: "The CPSU will make every effort to ensure that the USSR Armed Forces maintain a level preventing strategic superiority by the forces of imperialism, with comprehensive improvement in the defense capability of the Soviet State and strengthening of the fighting alliance of the armies of the brother socialist countries."

Attaching great importance to the specific tasks of strengthening national defense, our party addressed the question of the principles of Armed Forces organizational development back in its first and second Programs. In particular, the class foundation of the new army and its organizational principles were discussed.

The class foundation of the Red Army was defined in the 1919 Program, for example, as follows: "The Red Army, as an instrument of dictatorship of the proletariat, should possess an openly class character to the extent that this is needed, that is, it should be formed exclusively of the proletariat and semiproletarian segments of the peasantry, which are close to the proletariat." The experience of the first battles of the Civil War showed the correctness of this programmatic point, while the shift by the middle peasantry to the side of Soviet rule in the fall of 1918 made it possible to establish a mass worker-peasant army.

Toward the end of strengthening unity between army and people, the Party Program stated the task of giving extensive military training to all

proletarians and semiproletarians and establishing the closest contacts between military units and factories, industrial plants, trade unions, and organizations of the village poor. In addition, the Program pointed to the need to step up the forming of command personnel from conscious workers and peasants. First of all universal military training of working people -- Vsevobuch -- constituted practical implementation of these program demands.

The unity between the Soviet Army and the people demonstrated its insuperable strength in the grim years of the Great Patriotic War. Soviet citizens sacrificed everything for the war effort, for victory.

Our country and its Armed Forces have traveled a long journey since that time. The class foundation of the Soviet Armed Forces has changed, since qualitative changes have taken place in the political system, social-class structure, and nationality-ethnic relations of our society.

The CPSU Program adopted by the 22nd Congress stated that, having secured the total, final victory of socialism, the state of dictatorship of the proletariat had developed into a socialist state of all the people. The function of suppressing the exploiter classes, a function characteristic of the former, had long since withered away. The CPSU Program states that the Soviet Union does not need an army from the standpoint of internal conditions. For the first time in history our army had become a people's army not only in composition but also in function and its place within the system of political organization of the Soviet society.

Citizens of the USSR today serve in the Soviet Armed Forces regardless of race or ethnic affiliation, religion, education, social or property status.

At the same time the USSR Armed Forces, while having become totally popular, have not lost their class nature. The class character of our military is today clearly manifested in its historic function. Faithfully guarding the productive labor of the Soviet people, our military is called upon together with the brother armies to guarantee the security of the entire socialist community.

The totally popular character of our Armed Forces means that all Soviet citizens bear responsibility for the security of the homeland and for ensuring a high degree of troop combat readiness. This is why the draft new revised CPSU Program states: "Each and every Communist, each and every Soviet citizen shall do everything incumbent upon him to maintain our national defense capability at a proper level."

The party programs also represent a model of innovative solution by our party of the question of the forms of military organization and structural principles of Armed Forces organizational development.

As we know, in their first Program the Bolsheviks, guided by the instructions of K. Marx and F. Engels, focused on forming a people's militia -- arming all working people if it were to become necessary. Fierce resistance by the overthrown exploiter classes, however, and hostile encirclement by the capitalists, who possessed well-trained regular troops, demanded that this

problem be restated and resolved anew. And at the Eighth Congress of the RCP(b) [Russian Communist Party (Bolshevik)], which adopted the second Program, the party reached the conclusion that it was necessary to establish a regular cadre, highly-disciplined and well-armed military.

History has fully confirmed the correctness and the great significance of this party policy line in organizational development of the Armed Forces for the fate of the Soviet State. The Red Army, created as a regular standing army, held off the onslaught of the interventionists and White Guard in the flame of civil war, and inflicted a devastating defeat on fascism and militarism in the Great Patriotic War and World War II.

In its third Program, the Communist Party of the Soviet Union, taking the prevailing situation into account, stated the task of organizational and technical improvement of all arms of service, so that our army and navy would be at all times a precision, smoothly-functioning organism, possessing a high degree of combat efficiency and effectively utilizing the most sophisticated arms and equipment.

Pursuant to this program demand, considerable success has been achieved in recent years in strengthening the Soviet Armed Forces and in increasing their combat potential. Today all branches of the Armed Forces are equipped with first-class weapons and other military hardware. This is also evident in the example of our Air Forces. Today's Air Forces fly missile-armed supersonic all-weather aircraft. They have widely incorporated the latest achievements of the scientific and technological revolution: potent weapons, jet engines, electronics, and automated control devices.

The technical equipment of military aviation, just as was the case with all other branches of the Armed Forces and combat arms, was accompanied by continuous improvement of their organizational structure and enhancement of the level of combat and political training.

Complex, formidable combat equipment and weapons are in the reliable hands of people who are totally devoted to the party, to the homeland, and to the ideals of communism. Soviet aviation personnel perform service conscientiously and work persistently to master the heights of professional expertise. And when the homeland demands and internationalist duty calls, they carry out heroic deeds worthy of the fame of their fathers and grandfathers.

The present generation of aviators has also contributed vivid pages to the annals of heroic deeds. The names of Heroes of the Soviet Union party member-pilots V. Gaynutdinov, Ye. Zelnyakov, V. Kot, V. Ochirov, V. Pavlov, P. Ruban, V. Shcherbakov and others stand alongside the names of famed war aces. Military aviation personnel are operating with skill, boldness and determination in a complex situation, on alert duty, performing special missions and flying training sorties in conditions maximally approximating actual combat.

In view of the extremely complex international situation, the CPSU considers it essential, the draft new revised Program stresses, to continue in the

future unfailingly to concern itself with ensuring that the combat potential of the Soviet Armed Forces constitutes a solid fusion of a high level of technical equipment, military expertise, ideological firmness, organization and discipline on the part of personnel, and their faithfulness to patriotic and internationalist duty.

The tasks of military organizational development have become much more complex today, and the range of economic, political and, correspondingly, military problems which the party is called upon to solve in strengthening national defense has broadened.

The CPSU considers it essential, the draft new revised Party Program emphasizes, to continue in the future strengthening its organizing and guiding influence on Armed Forces life and activities, enhancing the role and influence of army and navy political agencies and party organizations.

These are the principal aspects of military organizational development in the Party Program. The draft new revised CPSU Program raises high the banner of peace and friendship among peoples. At the same time it clearly spells out the ways reliably to ensure the security of the Soviet State and the entire socialist community.

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## SOVIET COMBAT PILOT KILLED IN ACTION IN AFGHANISTAN

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[Article, published under the heading "They Were Decorated by the Homeland," by Col Ye. Besschetnov: "Safe Altitude"]

[Text] By ukase of the Presidium of the USSR Supreme Soviet, party member squadron commander Military Pilot 1st Class Lt Col Petr Vasilyevich Ruban has been awarded the title Hero of the Soviet Union (posthumously) for courage and heroism displayed while rendering internationalist assistance to the Democratic Republic of Afghanistan. Our journal's readers ask about him, about his military career, and what mark he left behind. The following piece tells about this intrepid son of the homeland, his life and military service, and his attitude toward military duty.

On that January morning the men of the squadron commanded by Maj P. Ruban arrived at the airfield early as always. At the muster preceding flight operations the squadron commander gave a more detailed briefing on the day's mission, which had been assigned the preceding day, and they proceeded without delay to ready the combat jets for the first sortie. Petr Vasilyevich, tall, with an athletic build, and filled with inexhaustible energy, proceeded from aircraft to aircraft, animatedly urging the men to speed up things and giving words of encouragement. Everybody had become accustomed to his indefatigable nature, his strong but fair demandingness, and nobody took offense at being the target of a critical comment. The squadron commander sensed that the men loved and respected him, and he knew that the men called him "Chapay" behind his back. And deep down inside he was proud of this.

They quickly readied the aircraft. The first to take a group [two 2-aircraft elements] out was the squadron deputy commander, Maj G. Chekhov. The flight was headed north. Fifteen minutes later the tower sent another flight up, this time southward, toward the town of Urgun. This group was led by the squadron commander. Capt N. Prikhodko flew as his wingman, and Sr Lt L. Sturov flew as Sr Lt V. Rassokha's wingman.

The pilots knew that counterrevolutionary leaders, not without the involvement of western "Afghanistan specialists," had devised a plan for armed seizure of Khost and Urgun, in order to proclaim an "autonomous Afghan state" on their territory. Several dushman [bandit, rebel] bands had dug in in the area, and elements of the Afghan army were engaged in fierce combat encounters with these bands. They needed air assistance.

Thirty minutes later the flight led by the squadron commander reached the objective area. Mountains, snow-covered in places, rose precipitously skyward in the southeast. Under a low cloud cover, which truncated the mountain peaks, distant points were obscured in a grayish haze. As they approached the target, the flight leader requested from the "ground" information on the environment in the target area. There might be problems: the aircraft could encounter heavy rebel fire.

Assessing the situation, Maj P. Ruban decided not to risk his men but to go in himself first, drawing fire, pinpoint dushman weapon positions, and only then send in the wingmen in order to bring accurate fire to bear on the targets. Ordering his wingmen to hold back, he headed toward the target.

Soon one stream of tracers and then another headed upward toward his aircraft.... Ruban instantly pinpointed the rebel weapon locations and radioed to the "ground": "Marking target with rocket fire. Adjust."

He attacked the first target and broke off. He swung around to attack the second target. His rockets also carpeted the other dushman weapon position which was spewing lethal fire. He pulled back on the controls, pulling his aircraft out of its dive, and immediately sensed that his right wing was riddled with bullet holes. A heavy machinegun had been firing from another bandit position. The aircraft began to spin slowly, out of control.

The squadron commander was able to radio to Viktor Rassokha, leader of the second 2-aircraft element, what had happened and, sensing that his aircraft was reaching a dangerously low altitude, assumed the ejection position, blew his canopy, and pulled the ejection handle. The explosive charge threw him and his seat out of the cockpit....

\* \* \*

Petr Vasilyevich was born in 1950 in the village of Khilchichi, Sumy Oblast. Grandfather Mikhail Vasilyevich and grandmother Yefrosinya Ivanovna Ruban devoted a great deal of care and attention to him. Petr was particularly attached to his grandfather. In those years he was still a strong, vigorous Cossack. During the Civil War he had fought for Soviet rule in the division commanded by N. Shchors, and he had fought in a partisan detachment in the Great Patriotic War. Mikhail Vasilyevich frequently talked to his grandson about those times, about his brother Ignat Vasilyevich, who had done his compulsory service in an aviation unit, and who had also fought as a partisan in the last war. Their sister had served as a scout-messenger in the detachment. The Fascists finally tracked her down and executed her in full view of her mother and fellow villagers. They then executed her mother as well....

Instilling in his grandson a love of the homeland and loyalty to Soviet rule, for which the people had shed a great deal of blood, Mikhail Vasilyevich also taught him the art of labor. When Petr was 14 years old he and his grandfather planted an orchard, which continues to bear fruit today, 30 years later. He learned the value of bread early in life: life was still difficult in those postwar years. During his summer vacation he cared for the geese and helped around the house. He saw how difficult it was for his mother, especially after his younger brother Mikhail was born. And although he wanted to complete his secondary education, he was forced to quit school: it was necessary to get on with the business of earning a living. After completing 8th grade, Petr enrolled in the Zaporozhye Metallurgical Technical School. He continued his studies there, but he also took a job at the Zaporozhstal Metallurgical Plant as a steelmaker's helper. Upon graduating from secondary technical school, he was made a steel teemer. He bought his mother a refrigerator and TV set with his earnings....

Petr really liked being a steelworker, but the sky had beckoned him since childhood. The young man had always wanted to try his hand at flying, and he applied to the Zaporozhye DOSAAF Flying Club. When he took his first parachute jump, he experienced an extraordinary surge of joy. It was as if new horizons had opened up before him. No matter how much he liked the profession of steelworker, he realized that his true calling was aviation. And this determined his entire subsequent life.

Events led Petr to his cherished goal. Service in the Air Forces, graduation from the Chernigov Higher Military Aviation School for Pilots imeni Lenin Komsomol, and honing of his professional skills....

In 1971 the young officer reported for duty at an aviation unit in the Baltic. They were flying a different aircraft -- a fighter-bomber. And the young pilot had to transition-train over to the new aircraft immediately. He displayed a great deal of effort and persistence, was very demanding on himself, and constantly felt dissatisfaction with his attained level of proficiency. Everybody liked his hardworking nature and his serious, responsible attitude toward his job. And it is quite logical that Ruban, as a promising, improving pilot, was fairly soon made a flight commander, during the second year of his tour of duty in the regiment. Regimental commander Lt Col A. Tarasenko, squadron commander Maj V. Kononenko, and his deputy commander for political affairs, Maj A. Kiryanov, did a great deal to ensure that he completed the initial orientation process as rapidly as possible and was able to acquire the requisite experience in indoctrination work with personnel. The flight he commanded became excellent-rated the very first year. Petr Vasilyevich became increasingly respected.

...The officers' club was especially crowded that evening. Aviation personnel had come to celebrate the anniversary of the Soviet Army and Navy. Government decorations were awarded to the top personnel. Sr Lt P. Ruban was warmly congratulated by his colleagues on being awarded the Order for Service to the Homeland in the USSR Armed Forces, 3rd Class. Not every officer receives such an honor.

P. Ruban then served a tour of duty with the Group of Soviet Forces in Germany. Now a captain, once again he had to transition-train onto a new aircraft. And in this new outfit as well he also earned universal respect and unquestionable authority. He was soon promoted to the position of regimental intelligence officer, and was subsequently made a deputy squadron commander. A year later he became a squadron commander.

How did he work with others? Capt V. Chernyak, a flight commander, who at the time was in his first duty assignment upon graduating from officer school, shared his reminiscences with me.

"He was always helping us in every way," said Capt V. Chernyak. "He would explain and demonstrate everything -- from flying in the pattern to the most complex training sorties to the range. He soon made his flight the top one in the squadron, and subsequently in the regiment as well. And he was very attentive toward others! If he saw that an individual was upset, you can be sure that he would go up to him to find out what the problem was. He would always give help and good advice."

Petr Vasilyevich was loved and respected in the regiment, and he was highly valued as a commander and pilot, a fine comrade and excellent family man. And they correspondingly paid him great honor. It was in large measure due to his energy, tireless labor and organizing ability that the squadron in which he served solidly maintained for several years running the title of regimental leader in socialist competition....

In June 1982 Petr Vasilyevich and several other of the pilots in his squadron were transferred to the Red-Banner Transcaucasus Military District. At his new duty station this officer once again had to transition-train onto a new combat aircraft. He already had experience in this area, and therefore he immediately, together with the squadron political worker, his deputy commander and executive officer, drew up a transition-training schedule and made sure that the men adhered to this schedule. He did a great deal of work on his own advancement, and he demanded this of his men.

In the squadron they made extensive use of the experience amassed by pilots who had taken part in giving internationalist assistance to the people of the DRA [Democratic Republic of Afghanistan]. These included military pilots 1st class squadron political worker Maj B. Kozyrev, holder of the Order of the Red Banner and Order of the Red Star, Capts N. Tsygankov, V. Shchelkov, and V. Bondarenko, and Military Pilot 2nd Class Sr Lt A. Lavrenko, all of whom were holders of the Order of the Red Star. The squadron commander was not embarrassed to learn from them combat employment of a complex aircraft system, and he frequently instructed them to address the novice pilots, to pass on to them all instructive items from their own practical experience. The squadron commander passed the required tests on schedule together with the rest of the men and proceeded with flying practical training sorties to the range.

News about the squadron's fine accomplishments soon spread beyond the regiment: the district newspaper devoted an entire page of one of its issues to publicizing the experience the squadron had amassed in mastering complex

combat equipment and developing excellent moral-fighting and psychological qualities in flight personnel.

The "Soyuz-83" [Alliance-83] exercise was a serious test of the combat proficiency of the squadron's fliers. During this exercise Maj P. Ruban was able for the first time fully to utilize the outstanding combat capabilities of his combat jet, and his performance was downright brilliant.

He was named among those who distinguished themselves at the exercise. The squadron commander received a commendation. We should note that by this time Petr Vasilyevich had accumulated quite a few awards and commendations attesting to recognition of his excellent military accomplishments. He greatly prized an All-Union Komsomol Central Committee certificate which he had received for success in combat and political training as well as skilled training and indoctrination of his men.

In the summer of that same year the command authorities asked Maj P. Ruban if he would head an air squadron in the DRA. He consented without hesitation. This officer reported for duty to assume command of his new squadron in mid-August.

Here in Afghanistan Maj P. Ruban's command and flying abilities were revealed particularly vividly. His unbending will, firmness of character, and his ability to inspire people, to compel them to do what at times seemed impossible were fully manifested. He also found time to organize intensive efforts connected with supporting combat operations of Afghan Army subunits, to keep an eye on the condition of the equipment, as well as to solve problems pertaining to daily life and off-duty routine, which at that time were quite acute. Frequently he himself would take active part in readying aircraft for missions, mounting munitions, and would not leave the flight line until every single aircraft was mission-ready. "he was literally indefatigable," reminisces squadron deputy commander for political affairs Maj A. Khokhlov. "Petr Vasilyevich proved himself to be a mature, well-trained commander, capable of accomplishing many difficult tasks independently, with initiative."

At the same time Maj P. Ruban also logged more flying hours than anybody else. He made an effort to fly a combat mission with each and every pilot in the squadron, to warn them against mistakes which could cost them their life, and to pass on his experience and know-how in delivering sure, precision strikes. In the air he always acted with initiative, boldness, and determination, defying danger.

...Early one morning a report was received that during the night a dushman caravan carrying weapons had crossed over the border into the DRA by concealed trails. But the caravan's present whereabouts was anybody's guess. One thing was clear, however: if the caravan was not intercepted, various dushman bands scattered throughout the province would be able to make use of the delivered arms, and they would once again perpetrate their foul deeds.

The squadron commander decided to fly the mission himself. Mission departure was preceded by thorough preparation. The pilots of his flight thoroughly discussed their sequence of actions, and soon the force was airborne.

Mountains marched past below them. In places snow-covered peaks rose past them, and they had to maneuver, sometimes swinging around and other times climbing and passing over the cols joining two peaks. This made it appreciably more difficult to find the target.

Finally they saw out ahead a gorge which they assumed the caravan had reached. Maj P. Ruban instructed his wingmen to intensify visual surveillance and led the flight along the gorge at a safe altitude. They were unable to spot the band. A second pass had the same result. At this point Maj P. Ruban, coordinating his actions with the higher commander, made a decision: he would leave one pair orbiting over the area, while he and his wingman would drop down and try to spot the caravan. He knew that this was taking a risk. It was possible that the dushman had set up weapons on the lateral slopes and might bring fire to bear on the aircraft. But he also considered another factor: the caravan could not be allowed to carry its cargo of weapons out of the gorge into the valley, where it would be much more difficult to intercept. Therefore the risk had to be taken, for it was essential to accomplish the mission. It became appreciably darker in the cockpit (the aircraft had flown into the shadow of a sheer cliff), but objects on the ground were now easier to make out. A stream wound its way along the floor of the gorge, flanked by the narrow ribbon of a road. The pilots closely scrutinized the floor of the gorge, but there was not a soul in sight. Suddenly, around a turn in the gorge, the squadron commander spotted at the base of a cliff an unusual cluster of objects which did not bear resemblance to rocks. He immediately realized that these were the horses and camels of the dushman caravan, while the bandits themselves had retreated to the shelter of the rock cliff.

Tracers streamed upward toward the combat jet: the rebels were firing heavy machineguns at the approaching aircraft, but they were wide of their mark. At the prescribed distance from the target, Maj P. Ruban squeezed the bomb release button in response to the hostile fire and pulled back on the controls. The aircraft shot upward, while explosions rumbled deep in the gorge, dislodging rocks from the mountainsides. Rocks now covered the only road running along the floor of the gorge, blocking the caravan's path. The wingman, Capt N. Prikhodko, repeated his leader's actions, after which the element led by Viktor Rassokha also followed suit. The stone "trap" slammed shut. The approaching Afghan infantrymen had only to disarm the caravan and seize the arms and ammunition....

Yes, Petr Vasilyevich would frequently take on the most difficult and critical missions. At the same time he realized that it was not enough just for him to be skillful and intrepid: it was essential that the other pilots in the squadron be likewise. But they included several young, inexperienced pilots. The squadron commander always made a thoughtful, detailed after-action review of each mission, endeavoring to pass on his experience and know-how to others. Flight commanders Capts N. Vdovin, V. Yeliseyev, and G. Kudinov, and pilots Capts V. Rassokha, A. Yakovlev, S. Gorokhov, L. Sturov, and Yu. Krylov, who subsequently were awarded the Order of the Red Star, learned a great deal from him. Thanks to the attention of the squadron commander and his deputies, the combat pilots rapidly became thoroughly familiarized with the situation, the

nature of the missions being flown, and learned to perform boldly, resolutely, and with initiative in the air.

And the missions were very difficult. They included flying cover for Soviet and Afghan troops, supporting movement along mountain roads by convoys carrying civilian goods and, at the request of the Afghan leaders, assisting in wiping out rebel bands and their arms and ammunition caches. Maj P. Ruban had flown a great many combat sorties in his four months with the limited Soviet forces in Afghanistan.

Some of his comrades recommended that Petr Vasilyevich direct his principal efforts toward organizing the activities of his men, but this meant that he would have to cut back on his flying. But the squadron commander was not one to remain on the ground when his men were aloft. He managed to divide his time between the ground and the air. The quality of his strikes was such that "ground" frequently requested: "Give us 141."

...On that fateful day, 16 January 1984, squadron deputy commander Maj G. Chekhov had returned with his flight to home base upon completing a mission. Upon taxiing to the ramp, he learned a shattering piece of news: the controls on the squadron commander's aircraft had been shot away and Petr Vasilyevich had ejected, but he was too low for the parachute fully to deploy.... And although officers V. Rassokha, N. Prikhodko, and L. Sturov had personally witnessed the entire incident, Major Chekhov simply could not believe it: "Could he have possibly survived?"

He changed aircraft and led his flight back into the area where the ejection had occurred. Perhaps they could do something for the squadron commander. But there was nothing they could do.... Petr Vasilyevich had died a hero's death. Two days before his death he had been promoted to the rank of lieutenant colonel.

He was put up for the title Hero of the Soviet Union for courage and heroism displayed in rendering internationalist assistance to the people of the DRA. The nomination reads as follows: "Military Pilot 1st Class P. V. Ruban performed his flight assignments with quality of good and excellent and hit his targets on the first pass. He flew boldly and surely. He always attacked ground targets resolutely, regardless of rebel antiaircraft opposition. He skillfully taught combat procedures to his flight personnel. He logged a total of 1,765 hours.

"Lt Col P. V. Ruban, constantly taking part in the conduct of combat operations, inspired his men by personal example to carry out their assigned missions. He was greatly respected by the men."

The command authorities, seeing that squadron commander Petr Vasilyevich was working a great deal and spending the entire time on the firing line, as they say, was given a short leave in December, one month before his death. He returned to the homeland and a joyful reunion with his wife and children. He told them a great deal about the life of the Afghan people, about the situation in that country, and about how Soviet military personnel were rendering invaluable assistance to the working people of the DRA.

P. Ruban's family frequently receives letters from those who served alongside him or who knew him well. Lt Col P. Tarutta wrote the following: "Petr Vasilyevich left a very bright mark with his outstanding career, his earnest performance of the duty of a military pilot, and his skilled organization of activities in the squadron. He lived, served and performed his duty as is fitting to a Soviet citizen, a patriot and internationalist." Maj G. Chekhov, who had taken over command of the squadron, stressed: "I can say one thing to you, Tatyana Viktorovna, and the children: Petr Vasilyevich lived a brief but brilliant life, and you can be justly proud of him."

The memory of this hero is imperishable. Secondary School No 62 in the city of Zaporozhye, which Petr Vasilyevich once attended, today bears his name. Out there in Afghanistan, where he last served, an award has been established in his name. It is given to those who have achieved the highest performance results in carrying out assigned missions. A corner honoring Hero of the Soviet Union P. V. Ruban has been set up in the combat glory room in an Air Forces unit in the Transcaucasus. It contains a large number of materials telling of Petr Vasilyevich's brilliant, outstanding career and his devotion to military duty. The unit's pilots compete for the honor of flying a combat sortie in the place of P. V. Ruban. This honor is given to the very finest performers.

"The hero lives on in our deeds. He is permanently on the rolls of this regiment," political worker Lt Col B. Kozyrev wrote the editors of this journal.

...At a critical moment over the battlefield, Lt Col P. Ruban lacked a few meters of altitude which would have enabled him to eject and land safely, but he succeeded in ascending to a spiritual altitude adequate to last a great many years, to open up for new generations of Soviet citizens, through the example of his life, his service career, and his performance of military duty, broad moral and ethical horizons, to point out the path of loyal service to the homeland and to those ideals which are infinitely precious and sacred to us.

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## PROBLEMS WITH PILOTS EXCEEDING AIRCRAFT OPERATING LIMITS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 86 (signed to press 2 Dec 85) pp 22-23

[Article, published under the heading "Constant Attention to Flight Safety," by Candidate of Military Sciences Col V. Dudin: "At the Bounds of Restrictions"]

[Text] The flight was proceeding without incident. After taking off and climbing out to the assigned flight level, Military Pilot 1st Class Capt A. Matveyev proceeded to accelerate his swing-wing aircraft. He cut in the afterburner, and the indicator needle shot to the right. Matveyev took a look outside the cockpit -- aviation weather was forecasting development of cumulus along the acceleration segment. The pilot gazed admiringly at the white caps of the cumulus buildup. It was located laterally from his flight path, and Matveyev continued to gaze at the buildup.

Suddenly the aircraft began to shake. The controls tried to wrench loose from his hand, and it was difficult to read the instruments due to the vibration. "Something is wrong with the controls," Matveyev concluded. The force and amplitude of the shaking were increasing. The next jolt caused the pilot to strike the canopy (his shoulder straps were not cinched tightly enough). Although his helmet took the brunt of the blow, he saw stars for a moment. "Malfunction... Malfunction..." the thought flashed through his head. His hands automatically found the ejection handles. The emergency ejection system functioned flawlessly....

While the cockpit data recorder tapes were being processed, the pilot, his superiors and ground maintenance personnel discussed various hypotheses. What had failed? But soon the impassive tape provided an answer -- the aircraft was in perfectly good operating condition. The ejection was a consequence of exceeding the maximum speed prescribed for the given altitude and wing sweep angle. It was precisely as a consequence of exceeding this performance envelope that the aircraft had "grabbed," with all subsequent phenomena.

Operating restrictions are established for each type of fixed-wing (rotary-wing) aircraft. It would seem obvious: all restrictions have been thoroughly computed by the designers, tested and refined during flight testing, and recorded in the pilot's manual (aircraft operating manual). If you know and

observe them, no problems will arise. Unfortunately there still occur in practical flight operations, however, incidents similar to the above. Both in single-seaters and in heavy aircraft, some pilots exceed stated limits on airspeed, G forces, bank angle, powerplant and systems operating parameters. Sometimes command personnel find out about this only after receiving a report from the tower controller team or analysis of the flight data recorder (SOK) tapes.

Aircraft do not always forgive such errors. When this happens, flight in a perfectly normally-functioning aircraft ends either in a near-mishap situation or in more serious consequences. Command personnel proceed to wrack their brains as to how the violation occurred. What caused it, and what could have prevented it? The answers to these seemingly simple questions are by no means elementary, and in addition are not unequivocal. Nor are the ways to eliminate incidents which negatively affect both a pilot's personal safety and the state of affairs in the subunit and unit simple.

The first basic condition for precise observance of operating limits by aircrews is careful and thorough study, periodic refresher-study and memorization of operating restrictions and limits. But difficulties arise thereby. On the one hand there occurs increasing complexity of aircraft, flying practices and, we must confess, swelling of the volume of manual materials which must be assimilated. Operating limits and restrictions are steadily growing in number, and they apply to the most varied areas of operation of aircraft systems. On the other hand, it is not easy to find time for this: the commander (ground) training schedule is jammed to the limit.

Under these conditions it is beneficial specifically to study and refresher-study operating restrictions and limits within a specific group -- today pertaining to airspeed, for example, tomorrow dealing with operating altitude, subsequently pertaining to powerplant and aircraft systems operation.... What is particularly important, a training class packed with material can be conducted within a limited period of time in the squadron and flight. Reading a specific section of the manual is combined with display of a diagram illustrating the essence of the topic in question, and with analysis of one or two (not more) examples of failure to heed a specific operating limit or restriction. It is useful to make such classes active in form, involving pilots in the discussion, especially ones with considerable flying experience, and combining lecture with asking questions. Practical experience indicates that it is advisable to select the directional thrust of a training class in conformity with the specific features of forthcoming training sorties and to go over those operating restrictions and limits which aircrews will be approaching in the course of flying training missions. For intercepts, for example, this would include the significance of speed and parameters of weapons employment; in practicing maneuvers it would involve angles of attack and G forces; in training flights at operating ceilings it would involve ceilings in relation to aircraft weight and ambient temperature, etc.

This is the way things are set up in the fighter regiment in which officer N. Tonkushin serves. Unit and subunit leader personnel do not pass up the slightest opportunity to increase the pilots' knowledge in the area of operation and combat employment of their aircraft. This produces substantial

results. The combat pilots conscientiously observe the specified limits, regardless of the complexity of the mission.

One of the most important factors in ensuring flight safety is instilling in aircrews conviction as to the firm and unwavering nature of operating limits and restrictions. This is achieved by strict observance of methodology of teaching young pilots and pilots transition-training onto a new aircraft. It is a difficult task to demonstrate all the capabilities of an aircraft and at the same time to instill in a pilot's consciousness the necessity of absolute observance of operating limits and restrictions, to teach him to determine the indications of approach to these limits, and to convince him of the danger of exceeding certain limits. Aviation commanders and instructor pilots should be clearly cognizant of the enormous damage caused to a student if he sees less than clean flying technique by his instructor and, in addition, if he sees conscious failure to observe the operating limits and restrictions established for a given aircraft. Seeking to emulate his senior comrade, a young pilot may proceed to violate operating limits and restrictions.

There is a considerable difference in observing operating limits and restrictions between practicing flying technique and mastering combat flying with complex maneuvers. Having satisfactorily mastered the established performance limits in "pure" flying (usually in the practice area), some pilots forget about these operating limits when flying intercepts, striking ground targets, and during air reconnaissance. One does not pay sufficient attention, another explains that it is due to his desire to "wring" every last bit of performance out of the aircraft, while still another is hoping that operating limits are specified with a safety margin. The experience of combat operations in the Near East, according to the testimony of foreign experts, convincingly demonstrates that a large percentage of failed attacks and aircraft losses were due to operating beyond various limits and restrictions. Stalls, collisions with the ground, fuel exhaustion, delay in ejecting from crippled aircraft, and damage caused by one's own munitions were a consequence of flying the aircraft beyond specific flight parameters and employment of weapons in excess of operating limits and restrictions specified in the manual.

Inseparably linked with teaching regulations and procedures pertaining to observing operating limits and restrictions is checking training sortie execution by each pilot (aircrew) on the basis of flight data recorder tapes, since the greater part of logged time is involved in flying beyond direct observation by command personnel and check pilots. With correct utilization of flight data recorder tapes, a system of continuous, systematic monitoring of the quality of mission performance is created. Perfunctory organization of objective verification, however, where unanalyzed, hastily interpreted tapes pile up from one flight operations shift to the next, leads to a situation where tapes are closely scrutinized only after a serious error or gross pilot violation of a major operating limit or restriction. And it usually turns out that the pilot had exceeded (or underestimated) the given parameter more than once, but nobody had established this fact or responded to the error. This is what happened, for example, in a training subunit in which two young pilots were engaged in competition with each other on who could accelerate to higher speed.

Sometimes pilots seek to rationalize violation of operating limits by claiming they were attempting to "expand" the combat capabilities of their aircraft (helicopter). Some pilots, especially young pilots, feel that conscientious observance of operating limits and restrictions is practically evidence of a lack of boldness and flying ability. But experience indicates that outstanding Soviet pilots have always had a disciplined attitude toward their aircraft's capabilities, and this, along with other qualities, has ensured them a long flying career. But it has also happened that veteran aviators, with many years of flying experience, including test flying, have gotten into (or, more accurately, have gotten themselves into) extremely difficult situations by failing to observe established operating limits and restrictions. Let us recall how many errors have been made when executing the turn onto final due to establishing an excessive bank angle. And is not descent below minimums in IFR weather in the absence of visual contact with the ground a typical example of violating an operating limit?

Such violations attest not to the boldness but rather the unthinkingness of the guilty party, his lack of genuine flying professionalism and the most elementary notion of flight safety.

Automated flight safety systems are employed on modern aircraft. These include various annunciator devices -- displays, lights, horns, voice devices, as well as limiting devices, limiting angle of attack and maintaining a safe altitude. It is every pilot's obligation to be totally familiar with these devices and to be able to utilize them as a system. It is intolerable to ignore such devices, and particularly manually to override them, as was the case with Lt Col V. Bokin. When practicing maneuvers in the practice area he overrode the automatic angle of attack limiter and put his aircraft into a stalling angle of attack.

Thorough knowledge of the parameters of operating limits and restrictions and the ability maximally to utilize the capabilities of one's aircraft will ensure every pilot reliability of flying activity and superiority over an aerial adversary, no matter how powerful and crafty he may be.

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## PECULIARITIES OF NIGHT VISUAL AIR RECONNAISSANCE

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 86 (signed to press 2 Dec 85) p 26

[Article, published under the heading "Constant Attention to Flight Safety," by Candidate of Medical Sciences Col Med Serv O. Baluyev and Candidate of Medical Sciences Lt Col Med Serv M. Polyakov: "Night Target Search"]

[Text] Modern tactics presume the employment of various techniques and modes of night combat. In this connection aircraft are playing an increasing role in detecting and destroying enemy offensive weapons in a prompt and timely manner, and an increasingly acute need is being felt for regular night visual reconnaissance.

The problem of increasing the accuracy of searching for and locating ground targets at night, while maximally ensuring flight safety, is highly complex. This is connected with the fact that man's eyesight is poorly adapted to perceiving objects in conditions of greatly-reduced illumination. Various means of illumination are employed to raise the level of lighting (illumination bombs, flares, illuminating shells). Aside from unquestioned utility, however, they also possess properties which negatively affect the process of visual perception of targets. Flight personnel must be familiar with them.

Visual aerial reconnaissance (VVR) employing a man-made source of illumination is complicated by the fact that a glaringly bright light source is positioned in the pilot's field of vision, which can cause a brief blinding effect. The pilot experiences a high degree of neuroemotional stress and constantly has the sensation of an acute shortage of time. In conditions of diminished illumination there occur a number of functional changes in the activity of the central nervous system and in the function of various analysors in the human organism. They are connected both with the diurnal cycle and with a sharp distortion and unaccustomed nature of the visual information perceived during a night flight.

As we know, the visual analyzor, with the aid of the adaptive mechanism, can change sensitivity by hundreds of thousands of times, in relation to the adaptation background. Precisely for this reason, in spite of poor illumination, during night flight a pilot is capable of getting his bearings

in the external environment and of distinguishing individual reference points and the line of the natural horizon. Light sources are perceived with a high degree of efficiency. Illumination bombs, for example, can be seen at a distance of more than 100 km, a bonfire -- 15-20 km, while vehicle headlights can be distinguished at a distance of 5-10 km from a height of 1,000 meters.

Change in perception of the environment with diminished illumination is determined by the peculiarities of night vision, which include narrowing of the field of vision, diminished sensitivity contrast, and impaired depth perception. The eye's color sensitivity also diminishes to a considerable degree with the onset of darkness. Night vision becomes almost achromatic and is distinguished by one peculiarity: at night one must look at poorly-illuminated objects not directly but at an angle of 15-17 degrees to the line of vision. The image will strike the retina with the greatest density of rods -- night vision regulators, which improves visual acuity. This is especially important when flying a low-level mission at a relatively high speed, when in order to ensure safety the pilot must continuously maintain visual observation of obstacles and high ground.

When conducting reconnaissance with the employment of illuminating devices, one should bear in mind that artificial illumination is nonuniform and is characterized by large differentials in luminosity values. In addition, incendiary devices create numerous burning points on the ground, the flickering of which hinders observation. This increases target detection time by tens of seconds.

Those sources of light which are in the pilot's field of vision affect the organ of vision. So-called physiological blinding occurs. Its development is connected with narrowing of the observer's pupil and scattering of the light flux from a glittering source, due to which an obscuring veil of light arises, diminishing contrast between object and background. The closer a glittering source to the observed object, the more marked physiological blinding becomes and the less effective target search becomes. To eliminate this phenomenon it is recommended that opaque screens be employed (cockpit canopy framing, palm of hand, clipboard) which totally shut off disruptive light sources. One can also lower the light-filtering helmet visor and utilize the screening properties of smoke from illumination devices, maneuvering to observe from a downwind direction.

Practical experience indicates that night aerial reconnaissance is conducted against a background of marked pilot neuroemotional stress. Regardless of the level of automation, an aircraft is flown on instruments during the process of reconnaissance, which requires of the crew continuous active efforts to gather and process information on the conditions of flight. In order efficiently to utilize each and every second for target search, it is essential to possess solid skills in estimating aircraft position and attitude from the instrument readings. Spatial orientation based on subjective sensations is one of the causes of serious pilot errors, which directly threatens flight safety.

Cases have occurred where during the conduct of visual aerial reconnaissance with the employment of illuminating devices, the pilot has erred in determining his spatial position. This is due to the fact that in such

instances he may spend not more than 60 percent of total flying time in the target area on reading instrument information, with a requirement of 90-95 percent. From the moment illuminating devices go to work, he is more frequently diverted to the task of searching for targets and bases his notion of aircraft attitude on the edge of the illuminated area, perceived as the natural horizon line. Experimental flights have indicated that when conducting visual aerial reconnaissance with the employment of illuminating devices, breaks in checking VVI, altimeter, and airspeed indicator readings range to 30-40 seconds.

Spatial disorientation results from intervals of interruption from monitoring the principal performance and navigation instruments, competition between the image of the illuminated area of ground and instrument-provided information, a bright light source positioned in the pilot's field of vision, a complex shadow pattern on the ground, and the peculiarities of twilight vision. The most probable disorientation errors include taking lights on the ground to be star-filled sky and a sensation of banking, pitch-up, diving, or inverted flight.

Experience teaches us that if any kind of disorientation occurs, the pilot must immediately check and compare the readings on his primary and backup instruments. Series of movements of the head and trunk, tensing the muscles, conversation with the tower or other crew members, and putting the aircraft into a simpler maneuver help end disorientation.

Night visual aerial reconnaissance with the employment of illuminating devices is a complex type of combat activity. It requires thorough preparation of aircrews on the ground. Only regular practice and drill sessions make it possible to diminish the harmful or interfering effect of negative factors of flight in these conditions. Comprehensiveness is the basic principle of training and preparation for night visual aerial reconnaissance missions. When readying for such a mission, crew members should be firmly aware of the demands placed on their psychophysiological preparation, should thoroughly master the distinguishing features of targets when illuminated by various devices, and practice combined skills in flying by instruments and visual search.

It is essential to maintain visual functions at a high level, which is achieved first and foremost by rigorous observance of work and rest regimen, diet, and regular athletic activity. A package of specialized physical exercises before and between missions helps activate visual analyzer and brain activity. Sponging with cold water is helpful. Recommended useful medicines include preparations which saturate the organism with vitamin A. Taking a tincture of Chinese magnolia vine, as well as vitamins B complex and C are reported to have a positive effect on twilight vision.

On the whole, success of night visual aerial reconnaissance with employment of illuminating devices is determined in large measure by the extent to which the

pilot understands the psychophysiological peculiarities involved with searching for targets in conditions of diminished illumination. And this depends on the quality and thoroughness of combined training and preparation for such missions.

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## DANGERS OF FROSTBITE DURING WINTER AIRFIELD OPERATIONS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 86 (signed to press 2 Dec 85) page 27

[Article, published under the heading "Your Health," by Col Med Serv E. Shormanov: "Thirty Below at the Airfield...."]

[Text] There are a number of specific features involved in aircraft operation and maintenance personnel work procedures in winter in conditions of low temperatures, factors which must be taken into account.

Pathological processes connected with cooling commence developing when the body temperature drops to 35-33 degrees C. This means that cold-caused affections can occur even when the temperature is above freezing. For this reason even in cool weather one should wear clothing at the airfield which has low heat conductivity and does a good job of maintaining a balance between the body's heat production and heat emission.

Frostbite or excessive cooling can occur with the presence of a number of adverse factors. These include rapid change in the weather, excessively tight clothing and footwear, which impede blood circulation and diminish local thermal regulation of body tissue, and the body's resistance to the effect of low temperatures. The isolated effect of any one factor on the organism is rarely encountered. As a rule these factors are manifested in a certain combination. In damp or humid air, for example, dampness of clothing inevitably increases, and this increases the clothing's thermal conductivity. Body heat losses increase substantially and can reach dangerous levels. Cold wind also leads to these results.

One must take particular care when below-freezing temperatures suddenly rise to close to thawing temperatures, accompanied by an increase in wind velocity and humidity. The body rapidly loses heat in these conditions, since it is unable to readjust its thermal regulation.

Tight footwear, tightly-wound puttees, and tight lacing of shoes in many instances hampers blood circulation in the legs. As a consequence there is an increased danger of frostbite, since flow of blood is restricted.

Footwear should not be dried by an open fire. This diminishes its elasticity and causes the appearance of roughness and folds, which promotes frostbite. For this reason it is very important rigorously to observe the established rules for drying footwear and clothing.

Two periods are distinguished in the development of frostbite: the first is a latent period (up to commencement of warming), while the second is a reactive period (after warming). Normal temperature of body tissue is restored in the reactive period, with subsequent manifestation of a varying degree of frostbite.

Aviation engineer service specialists must frequently work in field conditions, and sometimes they must work without gloves. At low ambient air temperatures it is necessary to be particularly careful in such instances, since contact with severely-cooled metal causes so-called contact frostbite.

If frostbite has occurred, how should one aid the victim? First one should warm up the frostbitten area as soon as possible. This is done with water heated to +37 degrees C. After this, the temperature of the water should be raised to +39-41 degrees in the course of 15-20 minutes. Damaged skin should be gently massaged from the edge to the center of the affected area. Active warming time runs 30-40 minutes. After this wipe the affected area dry, rub it with 70-percent alcohol, and apply an antiseptic bandage under a warmth-retaining thick layer of cotton wadding. If conditions do not permit giving a warm bath, any other source of heat can be used to warm the victim. In addition, the victim should be given hot tea and fed.

Cold-caused affections can have serious consequences. Therefore one can scarcely exaggerate the importance and significance of preventive measures. Protection against cold is a simple matter. It is important first of all not to allow the body to become excessively cooled. For this it is desirable to use warm, moistureproof, windproof clothing and footwear. It is precisely reasonable clothing and footwear rather than "flapping and hopping" which prevent frostbite. Driers and warming stations must be provided in aviation personnel work station areas.

Commanders organizing the training process should watch closely to ensure that their men observe working conditions which provide mandatory periodic warming periods in a warm room or at sources of heat. Burners and electric heating coils should be used, and hot meals should be brought to the airfield at suitable intervals. This will make it possible effectively to counter the effect of cold on the organism.

Unfortunately some people still are of the opinion that alcohol promotes rapid warming. This is a dangerous delusion, and here is why. Alcohol merely dulls the sensation of cold and diminishes critical reasoning in response to a situation, preventing one from assessing it correctly. All undesirable consequences ensue from this.

In order to be resistant to cold and to tolerate it without problem, one must participate more actively in sports and physically-condition oneself. Performance of measures to improve health and hygiene make it possible to

reduce cold-related affections to a minimum, and this means increasing the working efficiency of aviation personnel in conditions of subfreezing temperatures.

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## RELIGION CASTIGATED AS TOOL OF WESTERN INTELLIGENCE SERVICES

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 86 (signed to press 2 Dec 85) pp 30-31

[Article, published under the heading "At the Fronts of the Ideological Struggle," by Candidate of Philosophical Sciences Lt Col A. Fedurin: "Religion -- Weapon of Subversion"]

[Text] Religion holds a special place among the various means of ideological subversion used by imperialism in the historic contest between opposing ideologies. U.S. intelligence officer A. Dreyfus once made a very candid statement in this regard: "We can operate most aggressively by means of the church. The church is of great importance to us. It is the easiest and most reliable method of penetrating a country."

Imperialism, which is waging open psychological warfare against the USSR and its Armed Forces, assigns a major role to clerical anticommunism because religious consciousness functions not at a higher, scientific-theoretical level but at a lower, more mundane level. Our adversaries' inability to carry out their schemes by means of ideological polemics compels them to turn to the foulest techniques of manipulation of public consciousness.

U.S. psychological warfare theorist (R. Entman) writes: "There are vulnerable points in one's consciousness; they are to be found in an area connected with ignorance, lack of information, and prejudices. To identify and utilize them in propaganda means to control the behavior of such individuals." This is why all the most reactionary forces, including religious, are to act in a unified front, according to the strategy of the ideological centers and intelligence services of imperialism, in their "determined campaign" against communism.

In recent years clerical anticommunism has become one of the largest world reactionary forces. Right-wing religious circles are mounting sharp attacks on Marxism-Leninism, scientific atheism, and Soviet life. They ascribe primarily to lack of religious belief all difficulties experienced by mankind. It is not mere happenstance that, in endeavoring to give an appropriate ideological foundation to the program of expansion and world domination proclaimed by the most aggressive U.S. forces, U.S. ruling circles turned for propaganda purposes to religious phraseology and exploitation of religion. Washington is hypocritically explaining away many actions aimed at escalating

the arms race, sabotaging the process of detente, and stirring up anticommunism and anti-Sovietism with the need to fight "evil" and "godless communism", which must be opposed by all possible means "at the behest of the holy scriptures."

Western intelligence services generously finance reactionary religious centers, which faithfully carry out the social imperative of imperialism in the struggle against communism. There are more than 25 such centers and organizations in Western Europe alone. Many of these centers' executive bodies include former members of the Gestapo and SS, agents of foreign intelligence services and professional anti-Soviets. Hiding behind a concocted screen of claims about the "need for rebirth of religious spirit in Russia," they wage aggressive subversive activities against the Soviet Union and its Armed Forces.

Perhaps the most typical figure in this regard is one G. Vins. Back in 1975 the criminal division of the Kiev Oblast Court tried in open session the secretary of the Council of Evangelist Christian-Baptist Churches, G. Vins, accused of several crimes covered by the Ukrainian SSR Criminal Code. For a long period of time he lived as a parasite, systematically fabricated and spread slanderous lies defaming the Soviet system, for which "benefactors" abroad paid him generously and supplied him with religious-propaganda literature, copying equipment, motion picture and still-camera gear. In April 1979 this rabid anti-Soviet was expelled from our country. Lionized by reactionary circles in the West, he proceeded to become actively involved in an anti-Soviet campaign, along with other renegades masquerading as religious figures.

Today numerous reactionary religious centers, associations, leagues and missions specialize in the dissemination of slanderous lies about religious life in the USSR. Receiving their marching orders from intelligence services, they distort the USSR Constitution and concoct fables about the "coercive eradication" of religion in the Soviet Union, about the existence of an "oppressed church" and persecutions for belief in God, and take active part in subversive activities against Soviet citizens and our military personnel. A so-called Slavic Mission, for example, established the closest contacts with Western intelligence services, which instructed that it not only disseminate religious literature among Soviet citizens but also engage in outright espionage against the USSR. For ease of operations the mission has set up several base facilities in Europe, which coordinate agent activities. Reactionary religious centers make use of an entire system of modern devices aimed at subverting and softening up the socialist world: radio, television, special literature, etc.

The export of anticommunist ideas to the Soviet Union and the other socialist countries is today being carried out by an elaborate network of specialized radio-broadcast facilities, which include around 15 religious radio stations. In addition to these, Voice of America, the BBC, and other organizations broadcast regularly on anti-Soviet religious topics. All of them are financed by the CIA and the intelligence services of certain other Western nations, and propagandize not religious but rather anticommunist ideas. If one analyzes specific Western religious radio broadcasts, one readily notes that all of

them are designed to a considerable degree for persons containing political flaws in their ideology, persons stricken with nationalistic and religious prejudices, with immoral and unethical tendencies, and simply uninformed, gullible, unsophisticated individuals. Although the subversives of the airways cherish the hope of influencing as well persons with firm convictions, they are failing to do so.

The preachers of anticommunism devote considerable attention to the dissemination of reactionary literature in the USSR and other socialist countries. Concealed in religious "clothing," it in fact proves to be openly anti-Soviet -- it contains slanderous and inflammatory materials. Western organizations illegally spirit into the Soviet Union such pamphlets and books in brightly-colored jackets and leaflets bearing shouting title lines. According to the figures of the U.S. periodical TIME MAGAZINE, smuggling of literature is being conducted by a network consisting of at least 40 organizations.

A significant role in propaganda activity is played by a specialized publishing house located in Brussels, which puts out Russian-language literature for distribution in the Soviet Union. Jesuit (F. Lellot), for example, briefly presenting a "sacred story," reaches the eloquent conclusion that the "church should serve against communism"! He calls upon working people to "unite in Christ," for the interests of faith are allegedly higher than all else. The author attempts to convince the reader, contrary to the facts, that the church provides the only correct solution to all earthly problems.

Churchmen take upon themselves the mission of publicizing the Western way of life. The American way of life is extolled, for example, in a book by (R. Brukberzhe) entitled "The Face of America." The author turns to the United States with the entreaty to "hold back communism" and to "save" mankind from it. Therefore reactionary churchmen not only do not protest but outright support the arms race, utilization of space by the United States for military purposes, the development and stockpiling of chemical, bacteriological, and other types of weapons.

Persons who carry passports of neutral countries, coming to our country in the guise of businessmen and tourists, engage in the dissemination of religious wares. Counting on our traditional hospitality, for example, a female tourist from the Netherlands by the name of (N. Potye) tried to take along 275 books and pamphlets containing slander against the Soviet Union. A British traveler by the name of (R. Toburn), his travels sponsored by the emigre organization NTS, was supposed to spirit into the Soviet Union in special pockets 100 Soviet envelopes addressed to residents of various cities. The envelopes contained mini-copies of the journal POSEV, as well as appeals of an anti-Soviet nature and instructions on methods of conducting subversive activities in the USSR. This vile plot was nipped in the bud thanks to a high degree of vigilance by security personnel.

This murky flow of religious wares is not intended to "educate" Soviet citizens and members of the Armed Forces, as Western churchmen claim, but rather to sow seeds of skepticism in regard to the ideals of communism and

party policy. Once war veteran Professor A. Tsygankov found a letter from Austria in his mailbox. A brotherhood entitled "The Orthodox Cause Abroad," with which he was unfamiliar, was proposing that this "dear friend" fill in a gap in his education -- that he read pamphlets mailed to him and subsequently disseminate them among his friends. The pamphlets contained slander against socialism which, as the publishers admit, is not to their liking. This was followed by recommendations: to form small prayer gatherings and to make personal contacts with foreign representatives, who would teach them how to proceed in order to restore a "patriarchal Russia." There are many such examples. And the overwhelming majority of Soviet citizens indignantly reject such proposals.

Our ideological adversaries look for any opportunity to accomplish their ends. They count in particular on religious extremists. As a rule these are individuals with a murky past, adventurers and renegades, who have been repeatedly prosecuted for breaking Soviet laws. Attempting to hide their true countenance under the mask of religion, they in actual fact attempt to spread lies and slander against Soviet citizens, against our way of life. A large quantity of literature of anti-Soviet and nationalistic content, for example, filled with lies and appeals to fight "godless communism," was confiscated from religious sectarian S. Skalych, who had already served time for his participation in an organization of Ukrainian nationalists and for aiding and abetting the followers of Bandera.

The Soviet Armed Forces are a special target of ideological subversion by imperialism as a whole and in the area of religious issues in particular. The manpower and resources of the intelligence services of the imperialist powers, with religious extremists as active accomplices, are aimed at weakening the political state and morale of military personnel, at undermining the brotherhood among military personnel of different ethnic groups, and at distorting the activities of command personnel and political agencies in the area of atheist indoctrination of their men.

In some religious denominations there have been attempts to force young people to refuse to serve in the Soviet Army and to refuse to take a weapon in their hands. Naturally such actions are punishable by law. Therefore, it was noted at the June (1983) CPSU Central Committee Plenum, when we encounter cases of violation of socialist laws and subversive political activities under the guise of religion, we proceed as our Constitution requires.

Thus the ideological struggle in matters of religion is today not limited merely to a contest of ideas. Imperialism and reaction are mobilizing an entire aggregate of means aimed at weakening the Soviet Union and its Armed Forces with the aid of religion. In these conditions the CPSU Central Committee demands more active conduct of propaganda of scientific-materialist views among the public and that greater attention be devoted to atheist indoctrination, which also applies in full measure to personnel of the Armed Forces, and the Air Forces in particular.

The point is to improve the methodology of atheist activities in light of the demands of the party and to ensure that in the process of forming atheist convictions in personnel, commanders, political workers, party and Komsomol

organizations ground their efforts on scientific knowledge, the principles of Communist ethics and morality, and the practical business of development of a new socialist life.

Atheist indoctrination activity includes the following basic directions of emphasis: using all means of ideological influence to fill the consciousness of military personnel with systematized knowledge and scientific ideas about nature, society, and human thought, demonstration of the groundlessness of a religious view of the world; transformation of transmitted knowledge into firm, fully-conscious materialist convictions; development of atheistic behavior on the basis of these convictions, that is, actions by military personnel which are uncompromising as regards religion and the church, religious customs and ceremonies. One essential condition for effectiveness of atheist indoctrination is personal participation by every officer in propagandizing the fundamentals of scientific atheism and a personal example of an uncompromising ideological stand against alien ideology and morality.

Instructive experience in this important work has been amassed in many unit atheist indoctrination councils and agitation-propaganda groups. An oral atheist journal was put out as follows, for example, in the unit in which officer V. Starikov serves as political worker. Initially aviation personnel attended a lecture on use of religion by imperialism in today's ideological confrontation. Then officers, warrant officers, and primary-rank enlisted personnel used specific examples to demonstrate the purposeful nature of religious propaganda and its directional thrust aimed at various segments of the population on the basis of age and ethnic affiliation, especially young people, including induction-age youths and young servicemen. During the break members of the library council acquainted attending personnel with a specific-topic atheist literature book exhibit. The journal wound up with a viewing of documentary films and short subjects exposing religious "miracles," the true countenance of rabid anticommunists garbed in cassocks, as well as films calling upon Soviet civilians and servicemen to display political vigilance.

We must say that not only mass-political but individual forms of work activity are also skillfully utilized in this outfit. The first orientation lectures for new conscripts, correspondence with parents, fellow workers or students, and constant study of the men in the course of combat training and off-duty activities give commanders, political workers, party and Komsomol activists a clear picture of the presence or absence of religious-believer personnel in the subunit and unit, and when necessary help develop effective measures to free individual servicemen from the clutches of the opiate of religion.

"While championing strict observance of the constitutional guarantees of freedom of conscience," notes the draft new version of the CPSU Program, "the party condemns attempts to utilize religion to the detriment of the interests of society and the individual. The correct way to overcome religious prejudices is to increase people's labor and social activeness, their degree of enlightenment, as well as the establishment and broad dissemination of new Soviet rites and ceremonies."

Carrying out the party's instructions, working persistently to form scientific-materialist ideas and an activist experiential posture in military

personnel, and developing in them a faithfulness to communist ideals constitutes a crucial task of ideological work and the duty of all Communists and Komsomol members in military aviation outfits.

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## HISTORY OF AIR-TO-AIR COMBAT REVIEWED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 86 (signed to press 2 Dec 85) pp 34-37; first part of a multi-part article]

[Article, published under the heading "Tactics and Simulation," by Military Pilot 1st Class Col Yu. Kislyakov and Candidate of Military Sciences Col (Res) V. Babich: "History of Aerial Combat"]

[Text] World War I

Air combat as an armed contest between aircrews aloft has a history which dates back to World War I. Its content has continuously changed over the course of more than 70 years, with new elements and points being added. New types of weapons and combat equipment, as well as steady growth in the professional expertise of flight personnel have been the principal reasons for these qualitative changes.

The first aerial combat engagements were characterized by the fact that the participants were pilots flying aircraft which were not designed for engaging other aircraft in the air. Aviation subunits (at the beginning of World War I Russian aviation totaled 224 aircraft, German -- 258, French -- 156, and British -- 63 aircraft) performed missions of aerial reconnaissance and adjustment of field artillery fire, and subsequently antiaircraft artillery fire as well. Crews of reconnaissance aircraft entering hostile airspace would encounter antiaircraft artillery and machinegun fire. But the results achieved by the first antiaircraft defensive weapons were not very promising, and therefore it became obvious that reconnaissance aircraft should be engaged by other aircraft.

But how should combat be conducted in the air? At the time there were differing, quite unique opinions on this score. Military writer A. Radkevich, for example, gave the following advice in a manual on tactics entitled "Aviatsionnyye voyska" [Aviation Forces]: "A. Upon spotting an enemy aircraft, fly toward it, gradually climbing and flying over it, and drop a projectile onto it from above.... B. If the enemy aircraft is close by and is flying at the same altitude, approach it to a distance of 300-400 meters, and make a tight 180 degree turn, thus throwing an airstream (from the propeller) back, which can overturn the enemy aircraft...."

Similar and, quite frankly, highly naive recommendations were also given by some pilots. V. Grigorov, for example, noted in his "Taktika voyennogo letaniya" [Military Flying Tactics] (1913): "By skillful maneuvering close to an enemy aircraft, turbulent air is created, threatening the adversary with catastrophe." He immediately stated the following reservation, it is true: "Unskilled creation of such turbulent air could make one's own aircraft go down."

Theoretically substantiated, actually feasible suggestions were presented in addition to those such as the above. Vanguard Russian pilots were unanimous -- it was necessary to arm the aircraft. In 1913 military pilot Lieutenant Poplavko suggested employing the Vickers machinegun on reconnaissance aircraft. Such a machinegun was experimentally mounted in the nose section of a Farman-XVI. Test firings at aerial and ground targets were successful.

Things did not proceed beyond the testing phase, however. Sluggishness on the part of tsarist Russia's military leadership resulted in military aviation entering World War I unarmed. Pilots were compelled to seek out and employ variations of combat without fire. Two methods ushered in the history of aerial combat in Russian aviation: forcing the adversary to land, and deliberate midair collision with the adversary -- ramming.

In order to force the adversary to land, the attacker would execute maneuvers to frighten the opponent, that is, would create the threat of damage to the latter's aircraft (especially to its airfoils). Subjected to a psychological attack, the enemy pilot would find himself faced with a choice: either land on enemy territory or die. Only two weeks after the war began, on 4 August 1914 (old style), the newspaper RUSSKOYE SLOVO wrote: "...An interesting report has been received on an aerial battle between a Russian and German pilot. An enemy airplane suddenly appeared above the Russian lines. Our pilot expressed the desire to force the Germans to come down. He quickly took off, approached the adversary and, executing a number of banked turns, forced him to land. The German pilot was taken into custody." Subsequently this tactic was employed repeatedly (for security reasons, during the war Russian newspapers did not give the names of the pilots or types of aircraft involved).

P. Nesterov was the first to advance an exceptionally bold idea for downing an aerial adversary with an unarmed aircraft. He claimed that an enemy aircraft could be downed by striking it from above with the wheels of one's own aircraft, and he believed that the ramming aircraft could come out of it unscathed. It was stated in a report that Junior Captain Nesterov had quite some time ago decided to ram and down enemy aircraft. In the town of Dubno, for example, on 5-6 August he fitted a knife device to the tail end of the fuselage, which was to be used to slice open the skin of an enemy dirigible. During a stay in Zolochov, he resolved to fit to the tail of his aircraft a long cable with a weight, with which he hoped to foul the propeller of an enemy aircraft by crossing in front of it.

The first air-to-air combat and the heroic feat accomplished by Nesterov are known throughout the world. Anybody, even a person who has little acquaintance with flying, can easily imagine that ramming -- a highly complex combat tactic -- can be executed only by a pilot possessing exceptional

courage and the highest degree of flying skill. Gifted pilot-innovator Petr Nikolayevich Nesterov died a hero's death. But he had made a large contribution to the theory and practice of combat maneuvering -- the foundation of air-to-air combat. He had investigated the banked turn and had determined the necessary speed margin providing an increase in lift and ensuring that an aircraft executes a banked turn without gaining or losing altitude.

While executing banked turns at the steepest possible bank angle, that is, with a minimum turn radius, which is very important in aerial combat, Nesterov noted the phenomenon of "control surface shift" and warned pilots against excessive rudder movements; he demonstrated that the turn radius can be reduced by a simple control stick movement. It was precisely banked turn theory -- the "foundation" of horizontal combat -- which convinced Nesterov that with a sufficient energy level an aircraft can successfully execute a loop, which he himself successfully accomplished and which subsequently became the basic vertical combat maneuver.

Nesterov's practical recommendations helped many pilots avoid stalling and entering a spin at critical moments of combat. V. Tkachev, for example, described combat with a German Albatros as follows: "My Morane went inverted, and we began to plunge groundward.... Finally at factory chimney height I succeeded in bringing the aircraft out of it. I grazed an obstruction, banked hard right, and pulled back on the stick in the Nesterov fashion. After a 180 degree turn I brought the aircraft down safely onto a plowed field beyond the city walls. If I had not made the sharp turn, the aircraft would have ended up on some roof with its landing gear sheared off, or maybe worse. Nesterov's discovery of the function of the elevator in sharply-banked turns saved me from total disaster."

Nesterov had many followers among Russian military pilots. Military Pilot A. Kazakov, for example, scored one of his 17 unshared kills by ramming. His Morane did not carry armament. But Junior Captain Kazakov employed a special device -- a "koshka" [grapnel]. He mounted under his aircraft a spooling cable with movable claws on the end. Passing over an enemy aircraft at a height less than the length of the cable, he would try to snare it with his grapnel. At the moment of engagement a detonator would ignite, which in turn would detonate a cellulose nitrate charge attached to the grapnel.

Just as Nesterov, pilot Kazakov conducted practice sessions in the air (in-flight experimentation), but with a mechanism of a different design. Passing over a rope tied between two trees at a height of 5-6 meters, he would try to snare it with the grapnel. At the moment of grapnel contact a specially-devised blade would cut through a cord, and a weight tied to it would fall to the ground. According to the scheme, in combat this weight would describe a curve around an enemy aircraft and, tangling it with the rope, would cause the aircraft to crash.

On 19 March 1915, as he was flying to the west of the Vistula, Kazakov spotted a German Albatros and commenced pursuit. As he proceeded to unspool the cable, the grapnel caught on the fuselage, and the pilot decided to ram his adversary. His first pass missed -- he had erred in gauging height. His

second pass also failed. But the pilot stubbornly continued his "experiment." On the third pass the Morane struck the heavy Albatros with its landing gear. For several seconds the aircraft flew as one, and then the upper aircraft slid off and proceeded to glide. The Morane, with a smashed landing gear and shattered propeller, nosed over on landing, but the pilot survived. The German aircraft, however, plunged earthward and broke up upon striking the ground. Both crew members perished.

Russian pilots endeavored to achieve by all possible means the end goal of combat -- defeat of the adversary. Cases of successful employment of individual weapons in the air were recorded as early as 1914.

The German Taube reconnaissance aircraft frequently appeared above Russian troop dispositions. Lieutenant S. stalked him for quite some time, but was unable to force him into combat. Finally a combat encounter took place. The lieutenant endeavored to close on the Taube to within gun range. The aircraft maneuvered, each attempting to gain an altitude advantage. The men in the trenches closely watched the aerial duel. Finally, after a skillfully executed turn, the lieutenant got above his adversary and fired his pistol. He then repeated the maneuver and fired from the other side. The Taube was forced to land. The trenches reverberated with shouts of triumph. A Cossack mounted patrol galloped up to the spot where the aircraft had landed and took the German pilots -- two officers -- prisoner.

At the end of 1915 machineguns were mounted on some Russian aircraft, in the observers' cockpits, which were positioned forward of the pusher propeller. But in order to hit an adversary, it was necessary to overtake his aircraft. This was no simple feat, since the low-powered engines were unable to get the aircraft moving fast enough. Aircraft retired from production in France entered the Russian military air fleet. The owners of small aircraft enterprises in Russia as well as foreign companies were reluctant to adopt new designs, as they did not wish to retool. The worn-out aircraft were little effective in combat, and due to frequent structural failures and malfunctions aloft, pilots would be killed before they even encountered an aerial adversary. The chief of staff of the 12th Army reported to the High Command: "We have no engines, no aircraft, no machineguns -- we are totally unprepared.... Our young men are selfless, but we are almost sending them out to slaughter, with little chance of returning.... What is being accomplished, however, is beyond all praise."

The year 1915 was marked by another event in the history of aerial combat. The first combat engagement took place between the Ilya Muromets heavy bomber and three German Brandenburg aircraft. Over the course of a month's time two Ilya Muromets aircraft (the Kiyevskiy and III) successfully flew bombing strikes against enemy targets in the Yaroslav area, for which their crews were decorated. These damaging bombing attacks forced the Germans to set up ambushes along the routes of flight of the Russian aircraft.

On 6 July 1915 the Ilya Muromets Kiyevskiy, with a crew of four (pilots Lieutenants Bashko and Smirnov, artillery officer Junior Captain Naumov, mechanic NCO, subsequently Red Military Pilot, Lavrov) took off on a bombing mission, carrying a load of 13 poods of bombs. The crew carried a machinegun

and a carbine for self-defense. The crew dropped five bombs over their first target -- a field airstrip -- and proceeded toward their second target. At an altitude of 3,500 meters, above the reach of antiaircraft fire, 40 kilometers from the forward edge of the battle area, the ship was suddenly attacked by three Brandenburg aircraft. Naumov spotted the first through the belly hatch. The adversary overtook the Muromets and took up a favorable position for delivering machinegun fire (in contrast to the Russian two-seater aircraft, German aircraft had an engine mounted forward with a tractor propeller, and therefore fired only rearward). Machinegun rounds struck both upper gasoline tanks, one of the engines, and severed lines. Crew commander Bashko was wounded. The German pilot flew a second pass, but ran up against machinegun return fire. The aircraft banked sharply and plunged earthward.

The second German aircrew, fearing a similar fate, proceeded to fire downward from a considerable distance. Its machinegun bursts pierced the oil tank of the Soviet aircraft's second engine. Above the battle line a third Brandenburg proceeded to fire at it at an altitude of 1,500 meters, but was driven off by carbine fire (the machinegun had malfunctioned). Now above friendly territory, the Ilya Muromets ran out of fuel, and its motors stopped. Lieutenant Bashko, in spite of his wound, made a forced landing in a field near his home field. There were a number of firsts on this mission: air-to-air combat by a bomber, a bomber downing an enemy aircraft, and a safe forced landing in a field.

The German Fokker single-seat high-speed aircraft, carrying a machinegun firing over the propeller, appeared at the front at the end of 1915. The enemy now had an advantage in fire and maneuver. Pilot Petrenko (subsequently Red Military Pilot, awarded the Order of the Red Banner) and aerial observer Malishevskiy, flying a Farman-XXX, were among the first to engage a Fokker in combat.

Petrenko spotted an enemy aircraft flying at the same altitude. The Fokker was executing a 360 degree banked turn, attempting to come onto the Farman's tail. The Russian pilot chose the sole means of defense -- maneuver. Allowing the adversary to close to "critical" range, he then executed a tight turn to meet the Fokker head-on. Fearing collision, the Fokker broke away, after which it swung into a second pass, this time firing as it approached. It was very dangerous to fly tight turns with the decrepit Farman, and therefore Petrenko broke away from the pursuit by diving, bringing the aircraft into a crash-threatening situation. Following a forced landing, they counted 48 bullet holes in the aircraft.

This unequal combat reflects how difficult the situation was for Russian military aviation after one and a half years of the war. The meager aircraft fleet was not up to the demands of air combat. Heroism by flight personnel was making up for equipment shortcomings. A total of 25 officer-aviators (approximately 10 percent) and 115 enlisted personnel were awarded the Cross of Saint George in 1915. German military observer Major Morat wrote at that time: "...The Russian pilots are more dangerous than the French. There may be no planned, orderly manner in their attacks, but they are cool, composed, unflinching, and capable of taking heavy casualties without panic. The Russian pilot continues to be a daunting adversary."

Fighter aircraft first appeared in Russian military aviation in 1916. The higher-speed Nieuport and Morane aircraft (monocoque fuselage and monoplane) were added to the fleet. An organizational restructuring also took place. A report dated 2 July 1916 by the chief of aviation and lighter-than-air aeronautics to the chief of staff of the Commander in Chief stated: "The appearance of high-speed, heavily-armed enemy aircraft at the front has required that we form fighter detachments, the mission of which would be as follows:

"1. Protection of slower and poorly-armed aircraft when flying reconnaissance, photography, and artillery observation missions;

"2. Preventing hostile aircraft from carrying out reconnaissance of militarily-important installations and areas;

"3. Pursuit of enemy aircraft for the purpose of destroying them."

This document officially defined the basic combat missions of fighters, which modern fighter aviation also performs. But even prior to this official confirmation, the first 12 fighter detachments were formed in the spring of 1916, one per army, six aircraft in each detachment. The 1st Aviation Group, which contained four corps aviation detachments, was formed in August of that same year.

The newly-formed aviation group immediately went into action on the Southwestern Front, which was under the command of Gen A. Brusilov. The enemy had concentrated a powerful bomber force in the Lutsk area. On 13 September an element of eight Nieuport-X and Spad-VIII aircraft (on these aircraft the gunner-observer cockpits were placed forward of the propellers) encountered a force of 16 German bombers. The ensuing air-to-air battle, planned out in advance, well organized and executed, resulted in scattering the enemy force. Not one bomber made it through to Lutsk.

In the month of September Russian pilots fought approximately 40 air-to-air engagements, in which they downed three enemy aircraft over Russian territory, with several others going down beyond the battle line. Becoming convinced that air attacks were futile, in October the German command authorities withdrew their bombers from this sector of the front. For the first time local (tactical) air supremacy had been won, which left an appreciable mark in the history of Russian aviation. This was preceded by effective preparatory measures conducted in the 1st Aviation Group, which are of particular interest. (To be continued)

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## HELICOPTER CREW CHIEFS HELP IN TRAINING STUDENT PILOTS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 86 (signed to press .2 Dec 85) pp 36-37

[Article, published under the heading "Military Educational Institution Affairs," by aircraft technician, master-proficiency-rating WO G. Ozheredov: "Not Only the Flight Technician...."]

[Text] Indoctrination and training at a higher educational institution-flight school for future combat pilots is a rather complex process, requiring considerable efforts not only on the part of faculty, administration and instructor pilots, but on the part of other aviation personnel as well, whose labor would not seem to be intimately linked to training and indoctrination work. I am talking about us combat training helicopter flight technicians.

I would like to share some thoughts in this connection.

I remember once following a strenuous flight operations shift, helicopter flight technician WO V. Yevstigneyev complained to his colleagues: "Today we were very close to not getting a helicopter turned around and out on time. The cadets in our group are rather sluggish. They are very slow in their work procedures."

WO N. Burdin, also a flight technician, retorted: "You yourself are to blame...."

"How can you say that?" replied Yevstigneyev in surprise.

"At least for not teaching the pilot cadets affection for their aircraft."

"But why should I be indoctrinating the future officer-pilots?" asked Yevstigneyev. "They have commanders, faculty members, and instructor pilots for that purpose. My job is to ready the helicopter to fly...."

Unfortunately his opinion was shared by WO A. Kalugin and some of the other flight technicians. Indeed, the list of job-related duties of a helicopter flight technician does not state that he should directly engage in indoctrinating student pilots. But let's think about it: can today's pilot cadet become a good pilot if he does not have affection for the aircraft he

flies, if he has not studied it to a sufficiently thorough degree? Of course not. And we technicians and mechanics, working at the airfield together with future combat pilots, are simply obligated to help them acquire profound professional knowledge.

Take, for example, such a matter as instilling discipline and efficiency in a flight group. It is no secret that some of our flight technicians treat the pilot cadets with a considerable degree of familiarity. Is not this where we should look for the reason for sluggishness during flight operations on the part of some of the pilot cadets in the flight group handled by Warrant Officer Yevstigneyev? They simply felt that the flight technician had no moral right to take them to task for a poor-quality job on the helicopter. This is detrimental to the training process.

I recall that WO A. Lyulkin suddenly joined our conversation.

"Listen," he interjected, "in those flight groups in which the flight technician is a dependable assistant to the instructor in matters of training and indoctrination of pilot cadets and teaches them to service the helicopter in a knowledgeable manner and precisely to observe regulations governing flight operations, things do proceed better. The fact is that our lack of demandingness on the pilot cadets and our all-forgiveness can lead to undesirable consequences."

Unfortunately such instances are also encountered in our squadron. Once a student pilot, flying solo, got himself into a mishap-threatening situation, which could have been prevented in advance. And this should have been done by the flight technician. But he displayed a lack of demandingness, and the consequences were soon in evidence.

Probably every airman has experienced situations when by-the-book demandingness on the part of a superior or a person higher in rank has seemed carping and captious. I must admit that I myself have experienced such moments. Aircraft commander Capt V. Rybalko noted this in a prompt and timely manner, however, and explained the erroneous nature of such an attitude in a tactful manner, without injuring my pride.

"If your demandingness is fair, none of the cadets will take offense," he argued. "On the contrary, in time they will be grateful to you for the fact that you kept them from taking an incorrect action and helped them acquire those qualities which are essential to the military pilot."

Soon thereafter I received proof of the correctness of what the military instructor pilot 1st class had said. Student pilot A. Giliakhmetov always tried to climb aboard the helicopter without making a preflight inspection of the craft, although regulations prescribe that the crew make such an inspection. Quite frankly, I did not pay much attention to this. I was sure that all helicopter systems were in good working order, since I myself would preflight it. Therefore I considered an additional preflight inspection of the aircraft by the student pilot to be a meaningless formality. However, after my conversation with Captain Rybalko, who is for all of us crew members a model of conscientiousness and precise observance of regulations and

documents governing flight operations, I gave a good deal of thought to the fact that by my lack of demandingness I was actually doing the future military pilot a disservice. Having become accustomed not to preflight-inspect his helicopter, in the future Giliakhmetov might fail to notice mistakes by aircraft maintenance personnel. In addition, failure to observe rules and regulations could become habit, and this is fraught with serious consequences. Therefore, on the next occasion when the novice pilot tried to climb aboard without first preflighting the helicopter, I instructed him to make a walk-around inspection of the aircraft.

"But why?" the future pilot asked, and tried to get out of it by saying jokingly: "But I trust you."

I had to explain to him that any aircraft maintenance specialist, even one with a high proficiency rating, can make a mistake. The double inspection method makes it possible to spot any deficiencies in aircraft servicing.

"The most minor overlooked servicing operation or equipment problem," I explained to him, "can easily be corrected on the ground. It is frequently impossible to do so once aloft. For this reason the requirements of guideline documents are determined by practical realities...."

I accompanied the student pilot on a thorough walkaround inspection as prescribed by regulations. As we inspected I told him, and somewhat later the other pilot cadets in the flight group as well, what should be given primary attention and how a given problem can be spotted.

For the sake of fairness I should note that we did not return to the subject of the advisability of inspections. The pilot cadets, aware that precise observance of regulations was demanded of them, endeavored to carry out preflight procedures in a proper manner.

In addition, I used as much time as possible on the helicopter to increase the cadets' technical knowledge. The fact is that classroom material is assimilated more rapidly and skills are more solidly reinforced on a "live" helicopter. We examined and analyzed in detail the design and construction, function and operating principle of the various systems and devices. In these conditions one can require higher-quality answers from the cadets.

Gradually this taught the young aviators to engage in independent study of supplementary technical literature and other specialized sources. They began servicing their aircraft with greater initiative.

One can judge the results of such training activities by the fact that all the pilot cadets in Capt V. Rybalko's flight group passed the tests on knowledge of the aircraft with a mark of good or excellent. Subsequently, in thanking us technicians, flight group leader Sgt V. Vlasov stated that they would have been unable to master the combat helicopter so well if it had not been for our help in organizing practical training at the airfield.

Or take the following, for example. After the student pilots began flying solo, some of them showed indications of unwarranted self-assurance, although

they still were lacking practical skills. At this moment the main thing was to set the future pilot straight in a prompt and timely manner, and in other instances to compel a pilot to act in accordance with regulations. Experience indicates that an instructor pilot is unable to spot all infractions by a student pilot. Here too it is very important that the flight technician come to his assistance.

At one time some of the pilot cadets in our flight group were careless about tossing around the flight deck their clipboard with aeronautical chart. When I first made a comment on this score, the novice pilots expressed surprise: just what is the problem? I had to explain to them that when flying in rough air the clipboard could fall and jam the controls. On one occasion, when the instructor pilot's attention was drawn elsewhere, there was even an attempt to make a slight change in the flight plan, but my prompt warning over the intercom kept the student pilot from doing such a rash thing.

I believe that such an activist attitude on the part of the flight technician helps command personnel teach the future military pilots discipline on the ground and in the air. I know for a fact that other flight technicians do likewise, such as WOs N. Burdin and A. Lyulkin. And this unquestionably helps achieve successful flight training and indoctrination of pilot cadets as well as ensuring accident-free flying.

Somewhat later, following the conversation cited at the beginning of this article, squadron party activists synthesized the experience of our best flight technicians in working with student pilots. This was beneficial to many of the younger maintenance personnel, including Warrant Officers Yevstigneyev and Kalugin. I believe that instructor pilots have in these individuals not only skilled flight technicians but also reliable assistants in matters pertaining to training knowledgeable, disciplined military pilots.

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## SOVIET SHIPBOARD TELEMETRY MONITORING STATIONS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 86 (signed to press 2 Dec 85) pp 40-41

[Article, published under the heading "Space Flight Support," by Candidate of Technical Sciences Col V. Gorkov and V. Drogov: "On the Ocean as on Land"; first part of two-part article]

[Text] The principal difference between shipboard and land telemetry and tracking stations is perhaps the fact that the location of the former is not indicated on any geographic map. The work location of each one can change even from one communications session to the next. Deployment of ships in the World Ocean aims at eliminating periods of no communicationss with spacecraft. During manned orbital missions, five or six of the 16 orbits in a 24-hour period are beyond line-of-sight from Soviet soil, that is, interruption in communications could amount to as much as 9 hours. Calculations indicate that even two shipboard telemetry monitoring stations sited at specified points in the Atlantic Ocean can eliminate periods of no communications and ensure virtually uninterrupted monitoring of a space flight. Precisely this was the reason for establishing a space program support fleet. Its history is as follows.

The first interplanetary probe was scheduled for launch in 1959. Ballistic computations indicated that a tracking station in the Gulf of Guinea area in the Atlantic Ocean was required in order to monitor the initial segment of its flight. At this point a meeting was held, attended by merchant marine officials, ballisticians, radio communications specialists, and representatives of other areas of specialization, for the purpose of finding a solution to the problem. They sought not only to resolve this matter, connected with the flight of the first interplanetary probe. It was also essential to define in principle future technical policy pertaining to space mission support. The convened exeprts concluded that it was necessary to set up floating telemetry stations on oceangoing vessels.

Naturally any undertaking requires time. But time is precisely what was not available for designing and building such specialized ships. Therefore general-cargo ships of the Ministry of Maritime Fleet were refitted to serve as the first floating telemetry monitoring stations: the motor ships "Krasnodar," "Ilyichevsk," and "Dolinsk" of the Black Sea and Baltic

navigation companies. In August 1960 they set out on their first training cruise, and in February 1961 they went operational, receiving data from a space probe launched toward Venus. This was followed by support activities for unmanned spacecraft the launching of which preceded the first manned space flight.

On 12 April 1961 telemetry vessels deployed in the Atlantic Ocean and along the orbital path of the Vostok spacecraft received telemetry and scientific data on Yu. Gagarin's flight. Since that date not one launch of unmanned interplanetary probes and manned spacecraft has taken place without the participation of floating telemetry and tracking stations.

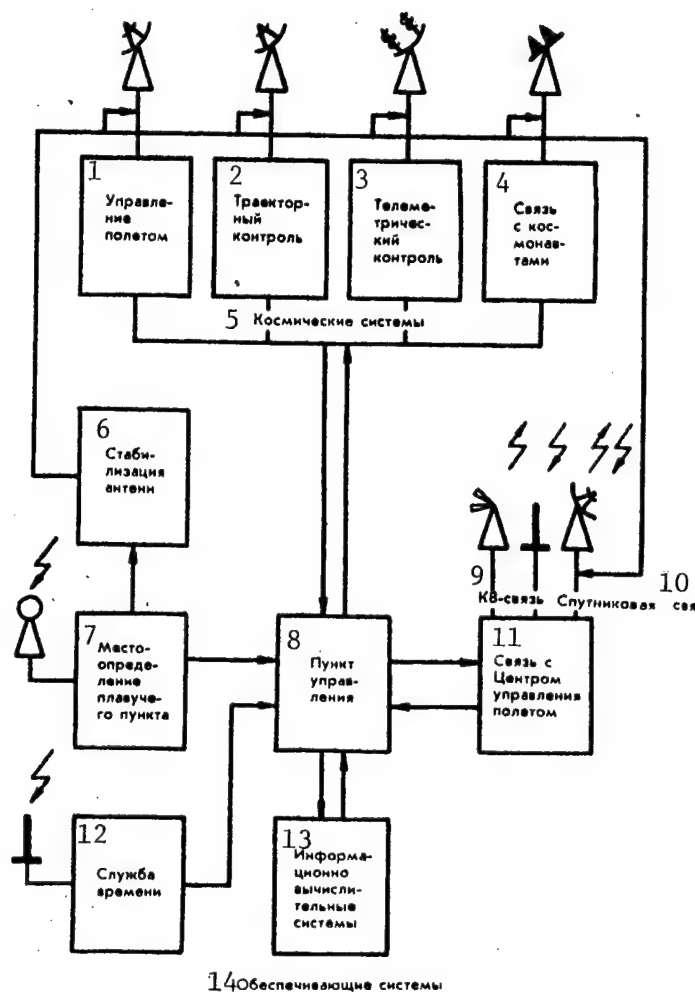
The principal requirement in developing this new type of vessel was to ensure technical compatibility of the equipment and psychological compatibility of personnel. Specialists in many areas of specialization serve on board every telemetry ship. Organizationally they are divided into ship's crew and equipment manning personnel. The crew's duties include navigation, technical servicing and maintenance of the ship's supporting systems, provision of meals, medical and other services for shipboard personnel. The technical personnel handle operations with space vehicles and the ship's electronic equipment. This is one aspect of the matter. Another involved the fact that it was necessary to install equipment of the same degree of accuracy. It was out of the question, for example, to install highly-precise navigation instruments and electronic equipment which met lower accuracy standards, and vice versa. In both instances quality of performance will drop to the lowest common denominator.

In addition, psychological difficulties are added to the specific difficulties (lengthy periods at sea, crowded living and working conditions, limited variety of daily contacts, vessel rolling and pitching). Difference in quality from one piece of equipment to another gives rise to emotional dissatisfaction on the part of one work team, while in conditions of limited-duration, highly-intensive communications sessions and rigid demands on work results, equipment failures aggravate this situation. For this reason the vessels of the telemetry support fleet were gradually improved, as were work methods. The first communications sessions were conducted while at anchor, for example, while subsequently personnel learned to conduct them during drift, and today when underway as well.

The experience gained in operating the first shipboard telemetry monitoring stations showed the need to design and build ships with greater unreplenished cruise capability. This makes it possible to perform with less manpower and resources the tasks assigned to the telemetry support fleet. As a rule a vessel's endurance would be limited by freshwater stores. Therefore modern vessels are equipped with water-distilling units. Increased endurance also naturally requires improved personnel living conditions.

A ship's stability and the related roll and pitch parameters are also a highly important characteristic of a telemetry ship. The designers of space telemetry-station ships must simultaneously accomplish two conflicting tasks. Ensuring maximum coverage angles requires placing antennas above deck superstructures. At the same time optimal weight distribution for ship

stability is achieved when the heaviest electronic equipment components -- the antennas with their massive bases and electric drives -- are positioned closer to the waterline.



### Floating Telemetry and Tracking Station Equipment

Key: 1. Flight control; 2. Tracking; 3. Telemetry monitoring; 4. Communications with cosmonauts; 5. Space systems; 6. Antenna stabilization; 7. Station position fix; 8. Control center; 9. Shortwave communications; 10. Satellite communications; 11. Communications with mission control center; 12. Time service; 13. Computer data systems; 14. Supporting systems

One must also consider the considerable antenna area presented to the wind. This figure is 1,200 square meters, for example, on the ship "Kosmonavt Yuriy Gagarin." The four main antennas weigh approximately 1,000 tons together with their base, and are mounted 15-25 meters above the waterline. When positioned "edge up," they turn into sails, which seek to overturn the ship. Therefore when the wind is high communications sessions are either cancelled or abbreviated, running in "traveling configuration," that is, aimed toward the

zenith. The programming command data was transmitted precisely from this position to the Soyuz 26 for docking with the Salyut 6, when a gale was blowing off Sable Island, where the "Kosmonavt Yuriy Gagarin" was on station.

A vessel's rolling and pitching creates certain difficulties for communications sessions with spacecraft. The angles to which a ship's deck tilts from the horizontal may exceed by tens of times the extreme antenna aiming accuracy values during communications sessions. In addition, equipment operating personnel working efficiency also diminishes. Therefore various roll and pitch damping devices are usually mounted on the vessels of the space telemetry fleet, in addition to antenna stabilization. But rolling and pitching not only worsen receiving and transmission of electromagnetic oscillations but also impose additional stress loads on the antenna stabilization system and overall on the ship's hull. Thus electronic systems deployed on board the telemetry ship place greater demands on strength and rigidity of the ship's hull.

There is an additional peculiarity typical of shipboard telemetry monitoring stations. The fact of limited space creates a complicated and hard-to-solve problem of electromagnetic compatibility of electronic equipment. The fact is that a large number of high-powered transmitters and highly-sensitive receivers, which in many instances must operate simultaneously, are concentrated on the ship's deck. In these conditions transmitters operating at frequencies close to receiving frequencies generate the greatest interference. Their nonprimary emissions also produce interference -- harmonics, subharmonics, combination frequencies, etc. Reemissions from masts, bridge, adjacent antennas and other structures also play a substantial role in generating interference. The electromagnetic environment is further aggravated by the fact that antennas rotate as they track a satellite. How can radio-frequency interference be combated?

The simplest, most obvious solution is the so-called method of spatial separation of signals. It calls for transmitting and receiving antennas to be placed as far as possible from one another. This can easily be done on land. But how can it be accomplished at sea? On ships, antennas must be dispersed on decks and masts. As a rule an effort is made to place receiving antennas at the bow and transmitting antennas at the stern. Frequency and time separation of electromagnetic oscillations are the principal techniques employed by shipboard telemetry monitoring stations, however. The first of these techniques involves selecting different frequencies for receiving and transmitting radio equipment, while the second technique consists in regulating the sequence and time of switching on receivers and transmitters.

In designing shipboard electronic facilities with high-powered transmitters, simultaneously with the problem of electromagnetic compatibility, engineers worked on the problem of shielding personnel from radio-frequency emissions. Shielding of ship's spaces was performed, and a system of warning signals was adopted.

The capabilities of a shipboard telemetry monitoring station are determined primarily by its equipment. Vessels displacing from 17,500 to 45,000 tons, such as the "Kosmonavt Yuriy Gagarin," "Kosmonavt Vladimir Komarov," and

"Akademik Sergey Korolev," can carry virtually the entire array of electronic equipment typical of a fixed-site tracking station. These facilities can transmit mission control commands and programs, measure the parameters of a spacecraft's motion, receive telemetry and scientific data, conduct radiotelephone and radiotelegraph communications with cosmonauts; in other words they can fully replace a land tracking station.

Vessels of up to 9,000 tons displacement, even if they employ sophisticated electronic systems which are more economical in size and weight, at present are unable to perform all the functions of the fixed-site telemetry monitoring station. For this reason they carry less equipment and perform a narrower range of tasks -- receiving of telemetry and scientific data from space, and radio communications with the crews of spacecraft and orbital stations.

The accompanying diagram shows the equipment of a general-purpose shipboard telemetry monitoring station. (To be continued)

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## BALLISTICIANS COMPUTE VEGA PROBE-HALLEY'S COMET RENDEZVOUS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 86 (signed to press 2 Dec 85) pp 41-42

[Article, published under the heading "The Space Program Serving Science and the Economy," by Honored Scientist and Technologist RSFSR, Doctor of Technical Sciences Professor A. Brykov, Lenin Prize recipient: "Toward Halley's Comet"; first part of multiple-part article]

[Text] In March 1986 the Vega 1 and Vega 2 unmanned probes will pass close to Halley's Comet. This will enable scientists to perform a unique experiment to determine its physical structure and chemical composition. Why are comets of interest to man? It is believed that the little-studied celestial objects of the solar system are close in their chemical composition to the primordial nebula from which the sun and the planets were formed. There is also a possibility that comets were involved in the history of the emergence of life on Earth. Scientists are counting on obtaining information which will expand our knowledge of the universe and planet Earth's place in it.

We shall begin our discussion of this unique experiment with trajectory computations for the Vega 1 and Vega 2 probes.

### 1. Ballistics of the Vega Probes

The Vega unmanned interplanetary probes (AMS) have performed a gravitational maneuver and have entered an orbital trajectory which will bring them into an encounter with the comet. The importance of this stage is due to the fact that the probes could enter the required trajectory path only if their planet flyby was accomplished with a high degree of accuracy. As we know, during execution of a gravitational maneuver, a planet acts as a diverging lens. Even a small deviation from the computed trajectory leads to a significant error from the desired path, which subsequently continues to increase.

A high degree of accuracy of maintaining the probes in their trajectory in the vicinity of the planet is essential not only for conducting investigation of Venus. In order fully to accomplish the mission program, it was necessary to work out with extreme accuracy a complicated system of operations connected

with delivering the probes into the designated area and separating the descent vehicles and balloon probes (the probes are to separate at an altitude of about 55 kilometers, land on the night side of the planet, and remain visible from Earth).

Experts from the most diversified scientific fields are taking part in executing the mission program. An important role is assigned to space ballisticians. Their main task consists in preparing data for controlling the flight with the required accuracy, reliability, and efficiency. But how is this achieved? The Vega probes are controlled with such operations as maneuver, path correction, and descent. Prior to each operation, the probe executes various turns and attitude orientation. Prior to executing a dynamic operation it is necessary to know not only where the probe is supposed to travel but also where it is actually traveling. The first task is determined by the flight program, while the parameters of the probe's motion are measured to accomplish the second task.

The array and placement of measuring devices, their accuracy and the required scope of measurements were determined at the probe design stage. The ballisticians in turn prepared methods of processing telemetry data, determining orbit, and predicting motion. On the basis of these methods they devised programs for solving ballistic problems on the computer, tested and debugged them, and performed a comparison verification in order to eliminate the possibility of errors.

A comparison of actual with desired orbit provides ballisticians with data for determining command information for executing a dynamic operation. These calculations are also performed according to prior-devised methods, algorithms and programs on the computer. After verification of data, command information is transmitted to the probe to activate the onboard devices taking part in execution of a given dynamic operation.

Each of the Vega probes was launched into an intermediate Earth orbit, from which it was boosted toward Venus. Two midcourse corrections were made in order to approach the planet with the required degree of accuracy for executing the gravitational maneuver and the scheduled sequence of operations.

The first correction was made in the initial segment of the flight (Figure 1). After the probe was boosted from Earth orbit (point O), navigational telemetry measurements were taken on trajectory segment AB by space command, control and telemetry system facilities. When the probe was in trajectory segment BC, computer centers processed telemetry data, determined the actual trajectory path, predicted the probe's subsequent motion and computed command information. At point C onboard equipment received commands and, as the probe was traveling on segment CK, performed preliminary observations for accomplishing the first midcourse correction. The midcourse correction motor was fired at point K. Following correction burn W, the probe continued on its journey toward Venus along the adjusted trajectory path. The arrow running to point K indicates that correctness of the midcourse adjustment was determined by monitoring telemetry data. The second midcourse correction was performed several days before reaching Venus (Figure 2). As in the first instance, navigational measurements were performed on trajectory segment AB, while all



computations pertaining to processing navigational measurements, determining actual trajectory path, predicting motion and computing command information were performed on segment BC. At point C information for preparing for the next dynamic operation was transmitted to the probe from Earth by radio command link (Figure 2). On trajectory segment CK all onboard devices taking part in the midcourse correction did final work on their programs. At point K midcourse correction burn W moved the probe into a planet flyby path. After passing Venus, the probe executed a gravitational maneuver and, utilizing additionally an active maneuver away from its previous orbital path (dashed line in Figure 2), transitioned to a new orbital trajectory, with a longer orbital period, traveling along which it should encounter Halley's Comet in March 1986. It is true that in order for this encounter to take place at the specified time with the required conditions, an additional probe midcourse correction is needed, and consequently performance of a complete cycle of ballistic computations.

In the described mission we have noted the principal ballistic problems which directly affect flight control. In addition there exist a number of other tasks without which a successful mission is not possible. For example, target designations are required for all stations of the ground automated control system, for without them ground facilities will be unable to make communications contact with the probes, plus calculation of restrictions on the operation of onboard systems in order to avoid, for example, exposing orientation system sensors. An important role is played by the problem of estimating accuracy of motion prediction. Therefore the actual accuracy of determination of orbital path and prediction of motion are computed during performance of each dynamic operation. And this requires methods and programs for estimating the accuracy of operation of telemetry systems.

Even this partial list of ballistic problems indicates how closely the process of controlling the flight of an unmanned interplanetary probe is linked to space ballistics and how important it is to solve all ballistic problems reliably, efficiently, and with a high degree of accuracy. (To be continued)

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## INTERVIEW WITH TEMPERANCE SOCIETY OFFICIAL

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 86 (signed to press 2 Dec 85) page 43

[Interview with Pilot-Cosmonaut USSR Col B. Volynov, member of the Central Council of the All-Union Voluntary Temperance Society, by AVIATSIYA I KOSMONAVTIKA correspondent N. Konkov, published under the heading, "Sobriety -- An Accepted Standard of Our Lives": "For the Sake of Man's Health"]

[Text] Attaching special significance to development of a mass anti-alcohol movement and its growth at enterprises, in organizations, at establishments and in workforces, the CPSU Central Committee considered it expedient and advisable to form an All-Union Voluntary Temperance Society. On 25 September 1985 a constituent assembly was held in the Hall of Columns at the House of Unions. It ratified the society's bylaws and elected a society Central Committee and Central Audit Commission. At the end of last year society primary organizations were formed at enterprises, on sovkhozes and kolkhozes, at establishments, educational institutions, and in neighborhoods.

AVIATSIYA I KOSMONAVTIKA correspondent N. Konkov met with Pilot-Cosmonaut USSR Col B. Volynov, member of the society's Central Council, and asked him a number of questions.

[Question] Boris Valentinovich, could you tell us about the aims and goals of the newly-formed society?

[Answer] First of all I should mention that strict observance of the principles of communist ethics and morality and overcoming such ugly phenomena as drunkenness and alcoholism are becoming particularly important today, when the creative, productive forces of the socialist system and the advantages of the Soviet way of life are becoming increasingly more fully revealed. The task of the All-Union Voluntary Temperance Society to campaign for sobriety is to unite in its ranks all genuine enthusiasts of the anti-alcohol movement, advocates of total elimination of the consumption of alcoholic beverages, and to arouse our country's masses to combat drunkenness and alcoholism. The society's nucleus and backbone of its organizations locally consists primarily of vanguard representatives of the working class and kolkhoz peasantry, who

have the ability to lead others with their personal example of an activist campaign for society. Important society activities include the forming of anti-alcohol public opinion, aggressive oral and printed propaganda, and enlightenment of the masses. It is necessary to explain in a vivid and persuasive manner that consumption of alcohol ruins people's health, has a baneful effect on future generations, and negatively influences all aspects of public and personal life. Publication of the magazine TREZVOST I KULTURA [Temperance and Culture], which is intended for the mass reader, is to promote these goals. This magazine, in addition to exposing the social danger of drunkenness, is called upon to counsel and advise people in organizing a healthy way of life and wise, interesting leisure-time activities. A substantial contribution toward transforming the public consciousness, changing people's psychology in light of the new demands, and toward the campaign against negative phenomena and for clearing our lives of drunkenness and alcoholism is being made by cultural and sports establishments. There are considerable capabilities in this area: 138,000 clubs and recreational centers are in operation in this country, and half a million specialist personnel are employed in the "cultural shop." Our 3,500 stadiums and almost 700,000 other sports facilities can handle approximately 30 million persons daily. The practical experience of the best cultural establishments and sports facilities indicates how much can be achieved if one approaches this business with a high degree of responsibility. For this reason the society will actively move into the domain of organization of the public's leisure time, in order to make it fully meaningful, activity-filled, ensuring that leisure-time activities develop people's creative and productive potential.

[Question] Obviously the All-Union Voluntary Temperance Society will not be able successfully to accomplish such a broad range of tasks on its own....

[Answer] Of course. Its activities will take place in a daily working interaction with party and government agencies, workforces, economic, trade union, and Komsomol organizations, public health, public education, culture, sports and tourism organizations, as well as this country's ideological and enlightenment establishments. For example, society activists at the local level will help accomplish more efficient implementation of administrative-legal and legislative measures aimed at forming a temperate and healthy way of life among the public at large, maintenance of order and organization, will assist the commissions to combat drunkenness, and will submit to the appropriate governmental and public organizations proposals that charges be brought against persons guilty of violating anti-alcohol laws. A great deal can also be done in the area of bringing order to trade in alcoholic beverages. An uncompromising campaign has always been waged against drunkenness in Air Forces units. This campaign is presently being stepped up. Drunkenness is an absolutely intolerable phenomenon in the military unit; it is the worst enemy of combat readiness. Commanders, political agencies, party and Komsomol organizations are working resolutely, consistently and with determination to root out this evil and are taking strict measures against persons with a weakness for alcohol. Success is being achieved wherever an atmosphere of intolerance toward consumption of alcoholic beverages has been created, where the ample resources offered by the facilities of officers' clubs, other club facilities, museums, libraries, Lenin rooms, and athletic facilities are effectively utilized to organize reasonable and intelligent

leisure-time activities for personnel, facilities at which activities encompassing all aviation personnel are conducted, at which amateur talent groups are formed, and at which various outings and excursions are organized. Indoctrinating aviation personnel in a spirit of temperance, an attitude of intolerance toward heavy drinking and drunkenness, vividly and persuasively showing the harm caused to combat readiness by even isolated instances of consumption of alcoholic beverages, conducting constant and continuous preventive work, and aggressively publicizing new traditions which eliminate the consumption of alcohol -- all these are important directions to take in further strengthening discipline and order and increasing combat readiness.

[Question] Boris Valentinovich, what can you tell us about anti-alcohol indoctrination of youth?

[Answer] Each generation places on young people its highest hopes and aspirations, its optimistic faith in a happy future. We are gladdened by the successes of our young pilots in mastering the newest and most advanced aircraft and in carrying out their internationalist duty. And we read and hear so much about the successes of the young specialist personnel who are designing modern machinery, machine tools, and precision instruments. The younger generation is working in vigorous rhythm with the entire country. Classes are in progress at our schools, secondary technical schools, and higher educational institutions, and research and innovative quest are continuing at scientific institutes. This journal's readership includes many persons of my age and members of the older generation. I should like to take this opportunity to address them. Be uncompromising toward any attempts to get young boys and girls drinking alcohol. Whether it is a glass of champagne, a mug of beer, or a shot of vodka -- one kind of alcohol is essentially no different from another. There is no such thing as a harmless dose! Don't let them take that glass of alcohol. This temptation can become the cause of great misfortune. Anything is possible if even a good man begins to be controlled by alcohol. By party word and paternal heart call upon young people to maintain absolute sobriety. It is to them we shall be passing the baton in building a happy, joyous, beautiful life in our country, turned toward the future.

[Question] Who can join the All-Union Voluntary Temperance Society?

[Answer] All citizens of the USSR who have reached the age of 18 and who constitute an example of abstinence from the consumption of alcoholic beverages and worthy conduct in public and in the home. Acceptance to society membership is done strictly on a voluntary basis, by a general meeting of a primary organization. There is an initial membership fee of 1 ruble, with annual membership dues in the same amount (20 kopecks for students and retired persons). Members will be given a membership card and a pin emblem. Personal involvement by each and every society member in the campaign to eradicate drunkenness and alcoholism is important. Therefore a fundamental requirement articulated in the bylaws is quite logical: activist personal work in one of the primary organizations. In conclusion I should like to stress that the measures adopted by the CPSU Central Committee to eradicate drunkenness are dictated by concern for the health of our people. There is perhaps no poison which assumes so many countenances and is so insidious as alcohol. Mothers

have shed countless tears over their drinking sons, and children over drinking parents. How many hopes and life's plans have come to naught due to alcohol! How many talents never blossomed and how many destinies never came to pass! The purpose of raising temperance and sobriety to a standard of conduct in our way of life is to elevate man, to make him stronger, more active and energetic.

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## CONTROLLING AIRCRAFT AERODYNAMICS WITH AUTOMATIC LIFT AUGMENTATION

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 86 (signed to press 2 Dec 85) pp 46-47

[Article, published under the heading "Practical Aerodynamics For the Pilot," by Doctor of Technical Sciences and Professor Maj Gen Avn M. Nisht and Candidate of Technical Sciences Senior Scientist Col V. Ostrovskiy: "Active Control of Aircraft Aerodynamics"]

[Text] The broad range of missions performed by the crews of modern combat aircraft requires continuous improvement in aircraft performance characteristics. It is not always possible, however, with geometric shape unchanged, to create a configuration with the required aerodynamic characteristics in all flight conditions. Only an aircraft with a variable geometric shape, that is, which adapts to specified flight conditions, can possess excellent aerodynamic properties throughout the entire operating range of airspeeds and altitudes.

Considerable possibilities are opened up in this area in connection with the employment of active control systems (ASU), encompassed by the term "tekhnika aktivnogo upravleniya" [active control equipment/technique]. The word "control" indicates purposeful, automatic influence, with the aid of normal or additional control surfaces, on an aircraft's most important aerodynamic characteristics. The word "active" stresses that the methods on which the new systems are based differ from previous "passive" systems, which give an aircraft specified characteristics only by selecting a specific configuration arrangement (for example, shape and size of areas of stabilizing and control surfaces, their location, center of gravity range, etc).

Modern airborne digital computers (BTsVM), sensors and electric-hydraulic drives have made it possible to alter "natural" aerodynamic characteristics in the required direction and to control an aircraft's aerodynamics.

We shall examine some examples of purposeful change in aerodynamic characteristics with the aid of an active control system.

In order to obtain excellent aircraft maneuver properties, an ASU can be employed to effect automatic change in wing section during maneuvering in such a manner that the best possible aircraft aerodynamic properties are achieved

at any angle of attack. The functions of the ASU boil down here to changing the  $K(C_y)$  relationship during wing section deformation, for example, with the aid of nose and trailing-edge flaps deflected to angles  $\delta_n$  and  $\delta_t$  respectively (Figure 1 on the back cover) [not reproduced]. The principles of adaptation of an ASU, which as a rule operates during maneuvering at subsonic speeds, are as follows:  $\delta_t = K_t \alpha_{man}$ ;  $\delta_n = K_n \alpha_{man}$ .

Proportionality constants  $K_t$  and  $K_n$  are selected for a specific aircraft with special nose and trailing-edge flaps in the process of aerodynamic computations and experiments. Figure 2 on the back cover [not reproduced] gives an approximate picture of these principles.

Relationship  $C_y(\alpha)$  changes during adaptation (Figure 3 on back cover) [not reproduced]. Lift coefficient increment  $\Delta C_{y-asu}$ , which is proportional to deflections  $\delta_t$  and  $\delta_n$ , and consequently to angle of attack  $\alpha_{man}$ , can be represented as  $\Delta C_{y-asu} \alpha_{man}$ . Change in coefficient  $C_y$  during maneuvering thus steepens curve  $dC_y/d\alpha$  by quantity  $\Delta C_{y-asu}$ . Change in  $C_y(\alpha)$  obtained as a result is indicated by the dashed line.

Deflection of nose flaps in relation to  $\alpha$  ensures shock-free airstream entry onto the wing's leading edge and makes it possible to decrease induced drag across the entire range of angle of attack variation. Figure 4 on the back cover [not reproduced] shows an aircraft's induced-drag polar curves for three cases: 1 -- nose flaps not deflected --  $\delta_n = 0$ ; 2 -- nose flaps deflected to constant angle  $\delta_n = \text{const}$ ; 3 -- nose flaps deflect in relation to angle of attack  $\delta_n = \delta_n(\alpha)$ . Deflection of nose flaps to a constant angle regardless of angle of attack (curve 2) produces an appreciable effect in decreasing induced drag coefficient  $C_{xi}$  within a very narrow range of change in lift coefficient  $C_y$ , in which conditions of flow across the leading edge are close to shock-free. The most appreciable effect is produced by adaptation during combined deflection of nose and trailing-edge flaps (curve 3) with optimal quantities  $K_t$  and  $K_n$  for each value of coefficient  $C_y$ . This ensures a smoother flow across the wing which, in addition to an increase in  $C_{y-max}$  and a steeper relation  $C_y(\alpha)$ , preserves its linearity and prevents flow separation up to maneuver high angles of attack (Figure 3 on back cover). Deflection of trailing-edge flaps increases wing lift, while deflection of nose flaps decreases drag. This increases aerodynamic efficiency during maneuver (curve 2, Figure 1 on back cover) by quantity  $\Delta K_{adapt}$ , with displacement of maximum efficiency  $K_{max}$  into a range of larger values  $C_y$  (see AVIATSIYA I KOSMONAVTIKA, No 6, 1985).

Thus an adaptation ASU is capable of controlling relation  $K(C_y)$  and makes it possible, without increasing drag and therefore without changing engine thrust, to increase lift, G forces, and correspondingly an aircraft's maneuver capabilities. Reduction of flow-separation phenomena on the wing at high angles of attack also diminishes the negative effect of the wing on flow over the tail, as a consequence of which stability and controllability characteristics also improve.

Here is another example. Improvement in an aircraft's maneuver characteristics by improving aerodynamic efficiency can also be achieved by decreasing an aircraft's G forces longitudinal static stability margin p-y.

Longitudinal static stability is achieved by placing an aircraft's aerodynamic centroid aft of its center of gravity. If this is done, when disturbances occur which cause a change in angle of attack, the aircraft eliminates this change without pilot intervention. This meets one of the mandatory conditions for achieving required stability and controllability characteristics. But during flight with lift Y, static stability pitching moment  $M_{zcy}$  is generated, which turns the aircraft to a smaller angle of attack, that is, toward a decrease in Y:  $M_{zcy} = -Y(X_f - X_t)$ . Quantity  $X_f - X_t$ , as the difference between the coordinates of the aerodynamic centroid and the center of gravity, is positive in a statically stable aircraft, while a minus sign indicates that moment  $M_{zcy}$  is directed pitch-down with positive lift. This quantity, as a percentage of  $B_{cax}$ , constitutes the quantitative measure of G forces longitudinal static stability margin p-y.

In addition to moment  $M_{zcy}$ , an aircraft in flight is affected by pitching moment  $M_{zo}$ , caused by airframe asymmetry. An aircraft has this moment with lift  $Y=0$  and horizontal stabilizer position  $\phi=0$ . By deflecting the stabilizer from position  $\phi=0$ , the pilot generates moment  $M_{z-\phi}$ . Assuming the moment of engine thrust on axis  $oz=0$ , resultant pitch moment  $M_z$  at a specified angle of attack will be equal to the sum of moments  $M_{zcy}$ ,  $M_{zo}$ , and  $M_{z-\phi}$ . Due to the existence of a longitudinal static stability margin, moment  $M_z$  is determined by the angle of attack. Figure 1 shows the nature of this relationship when  $\phi=0$  ( $M_{z-\phi}=0$ ). Case 1 corresponds to an aircraft with a "normal" p-y longitudinal static stability margin, which is satisfactory to the pilot, while case 2 is with a diminished margin. We shall note that the greater the difference in coordinates  $X_f - X_t$  (case 1), the more strongly the relationship between moment and angle of attack is manifested (the greater the angle of slope).

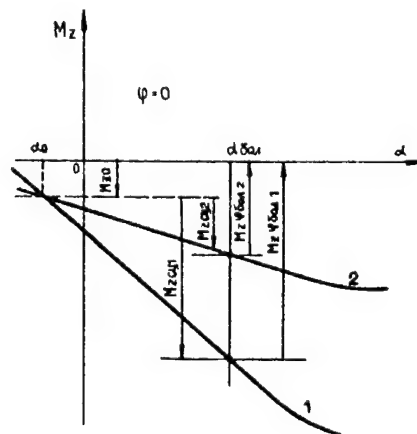


Figure 1. Relationship between pitching moment  $M_z$  and angle of attack for aircraft out of trim.

In order to meet steady-state conditions, such as level flight, steady bank-angle turn, etc, that is, flight at a constant angle of attack, pitching moment  $M_z$  (moment of all forces relative to axis  $oz$ , passing through the aircraft's center of gravity) must be equal to zero. In order to fulfill this condition, called aircraft trim, at angle of attack  $\alpha_{bal}$ , for example, the pilot deflects his stabilizer to trim angle  $\phi_{bal}$ . This generates moment  $M_{z-\phi_{bal}}$ , equal to  $-M_{z-\phi_{bal}} = M_{z0} + M_{zcy}$ .

The minus sign indicates that this moment is opposite to the sum of moments  $M_{z0} + M_{zcy}$ , that is, at a positive angle of attack it causes pitch-up. In absolute values  $M_{z-\phi_{bal}} > M_{zcy2}$  (Figure 1), because  $M_{zcy1} > M_{zcy2}$ . Thus the greater the difference  $X_f - X_t$ , the larger will be the stabilizer deflection angle  $\phi_{bal}$  required to trim the aircraft.

With positive lift and difference  $X_f - X_t$ , trim deflection decreases stabilizer lift and lift of the entire aircraft as a whole and, as a consequence, lessens aerodynamic efficiency. This phenomenon is called "trim losses." The greater the lift or longitudinal static stability margin, the greater the losses will be. Consequently, in order to achieve greater aerodynamic efficiency, it is desirable to have a smaller longitudinal static stability margin.

After the aircraft is trimmed, relation  $M_z(\alpha)$  will assume the form shown in Figure 2. Now with a change in angle of attack by quantity  $\Delta\alpha = \alpha - \alpha_{bal}$ , for example, during the effect of a vertical wind gust, out-of-trim moments of static stability  $\Delta M_{zcy1}$  and  $\Delta M_{zcy2}$  will arise. On an aircraft with a reduced longitudinal static stability margin, moment  $\Delta M_{zcy2}$  will be less in absolute magnitude than moment  $\Delta M_{zcy1}$  in an aircraft with a "normal" margin and, consequently, the aircraft's tendency to return to a trimmed state will be less. The pilot is forced to intervene in control and stabilize the aircraft, whereby the aircraft's stability and controllability characteristics worsen.

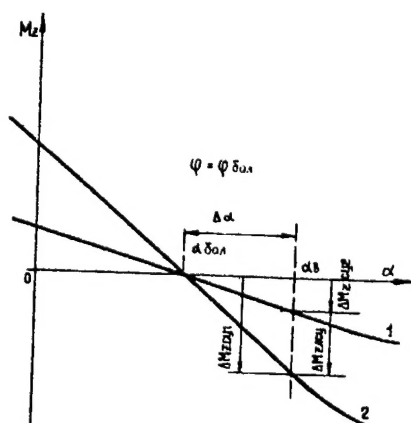


Figure 2. Relationship between pitching moment  $M_z$  and angle of attack after trimming aircraft at angle  $\alpha_{bal}$  (for those same instances as shown in Figure 1).

Thus a significant decrease in G forces longitudinal static stability margin, advisable from the standpoint of decreasing trim losses and increasing aerodynamic efficiency during maneuver, leads to a worsening of stability and controllability characteristics, which in general is objectionable.

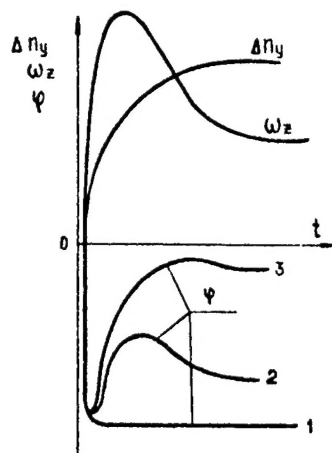


Figure 3. Transitional G-force  $\Delta p-y(t)$  and angular rate  $\omega_z(t)$  transitional processes (upper part) and stabilizer deflections causing them (lower part).

An ASU eliminates this conflict. With a decrease in static stability it generates additional moment  $\Delta M_{zasu}$ , which artificially increases the aircraft's static stability and maintains stability and controllability characteristics at the desired level (Figure 2):

$$\Delta M_{zcy1} = \Delta M_{zcy2} + \Delta M_{zasu}.$$

Since moments  $\Delta M_{zcy1}$  and  $\Delta M_{zcy2}$  are proportional to change in angle of attack, moment  $\Delta M_{zasu}$  should also be proportional to the angle of attack. Therefore the stabilizer ASU control principle is selected as follows:

$$\phi_{-asu} = K_{\phi} \Delta \alpha,$$

where  $K_{\phi}$  -- proportionality constant between angles  $\Delta \alpha$  and  $\phi_{-asu}$ , produced by the ASU.

When moving away from a balanced state, that is, when  $\Delta \alpha$  appears, an additional moment of "artificial" static stability arises alongside moment  $\Delta M_{zcy2}$  in an aircraft with a reduced stability margin and operating ASU, due to automatic stabilizer deflection. This additional moment is equal to  $\Delta M_{zasu}$ , which is proportional to stabilizer automatic deflection angle  $\phi_{-asu}$  and to change in angle of attack  $\Delta \alpha$ .

Sum stability moment  $\Delta m_{zcy}\Sigma$  will now be equal to  $\Delta m_{zcy}1$ , that is, to aircraft moment with "normal" margin.

Expressing moment  $\Delta m_{zcy}\Sigma$  by aerodynamic coefficients, in conformity with the above, we obtain:

$$\Delta m_{zcy}\Sigma = (m_{z2}^a + m_z^{\varphi} K_{\varphi}) \Delta \alpha = m_{z\Sigma}^a \Delta \alpha.$$

This means that ASU operation in a physical sense is equivalent to change in aerodynamic derivative  $M_{\alpha-z2}$ , that, change in position of aerodynamic centroid coordinate  $X_f$  by an amount requisite to ensure the desired aircraft stability and controllability characteristics and with a smaller longitudinal static stability margin. Reducing this margin, one can obtain a gain in aerodynamic efficiency --  $\Delta K_{bal}$ , which is particularly appreciable with large  $C_y$ , that is, when maneuvering at medium and high altitudes (Figure 1 on back cover). The sum effect of increasing efficiency achieved by the ASU in both examples is indicated in this diagram by relation 3.

ASU operation on an aircraft with diminished longitudinal static stability margin can also be illustrated with Figure 3. G-force increment  $\Delta p-y(t)$  and angular rate  $\omega-z(t)$  transition processes from pilot stepwise deflection of the pitch-up control, typical of an aircraft with good "natural" stability and controllability, are depicted in the upper part of the diagram. Stabilizer deflection  $\phi-l(t)$  is indicated by relation 1 in the lower part of the diagram (no ASU). These same transitional processes can be obtained with pilot stepwise deflection of the control stick in aircraft with diminished longitudinal static stability margins but with operating "artificial" stability ASU. The nature of stabilizer movement  $\phi-\Sigma = \phi-ASU + \phi-l$ , however, will vary, depending on degree of diminished G-force longitudinal static stability margin (lower part of Figure 3). With a reduced margin, stabilizer movement will be described by relation 2 due to ASU intervention in aircraft control, and by relation 3 with a margin close to zero. Consequently, with a suitable choice of coefficient  $K_{\phi}$  one can obtain, regardless of longitudinal static stability margin, identical  $p-y(t)$  and  $\omega-z(t)$  transitional processes with identical control movement; in other words, one can obtain identical stability and controllability characteristics.

Here is one additional example. As we know, the presence of "spoon" type nonlinearities in pitching moment characteristic curve  $m-z(\alpha)$  leads to restriction of flight conditions, required for which are angles of attack  $\alpha$  greater than instability onset angle of attack  $\alpha_{nn}$  (Figure 4). This is due to the fact that the presence of a "spoon" leads to an intolerably low longitudinal static stability margin, close to zero, or to static instability, in angle of attack range  $\alpha_{nn} - \alpha_{vu}$ . Usually at high angles of attack  $\alpha > \alpha_{vu}$ , stability is restored, but nevertheless flight at angles of attack greater than  $\alpha_{nn}$  is undesirable. In this instance an active control system removes this restriction by "correcting" moment characteristic  $m-z(\alpha)$  in angle of attack range  $\alpha_{nn} - \alpha_{vu}$ . In the case at hand the ASU operating principle is the same as in the second example, but stabilizer control principle  $\phi-ASU = K_y \Delta \alpha$  is implemented by means of selection of  $K_{\phi}$  only at angles of attack  $\alpha$ -

$m_{\alpha} < m_{\alpha_{vu}}$  (Figure 5). The coefficient increment  $\Delta m_{\alpha} = M_{\alpha} - M_{\alpha_{vu}}$  obtained in this case "smooths" the moment characteristic curve, that is, one achieves a normal curve during change in angle of attack (dashed line in Figure 4). The restriction in this angle of attack range is removed, which also leads to improvement in the aircraft's maneuver characteristics.

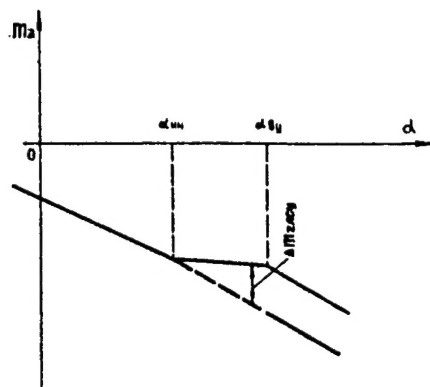


Figure 4. Change in moment characteristic  $M_z(\alpha)$  with the aid of an ASU for removing angle of attack restrictions.

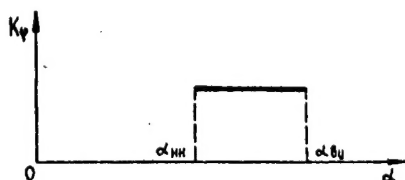


Figure 5. Change in value of coefficient  $K_{\phi}$  of an ASU designed to expand the range of angles of attack

In conclusion we should stress that one can change aerodynamic characteristics in the desired direction and improve an aircraft's flight performance characteristics thereby with sufficient effectiveness only if the decision to employ an ASU was adopted during selection of aerodynamic configuration, that is, when the aerodynamic configuration takes into account the capabilities of an ASU with appropriate selection of controls.

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